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THE MANUFACTURE OF DOLLS AT PARIS.

TOYS offer no less interest from an industrial than from a scientific standpoint, as will be seen from what follows. Before a visit that we had an opportunity of making to the celebrated doll factory of Montreuil, near Paris, we had no suspicion of the importance that a special industry of this kind could attain. The founder and director of these works, Mr. Jumeau, whose name is universally known, was good enough to do us the honors of his establishment with the greatest obligingness, and we here-with address our thanks to him. We are going to try to make our readers share our astonishment and wonder with us at the sight of so well organized an establishment. This latter manufactures nothing but fancy dolls, with porcelain heads and cardboard bodies, and is the most extensive manufactory of the kind in the entire world. There are others that manufacture cheap dolls, and wooden, jointed ones, but we shall not occupy ourselves with these in this place.

The heads of the dolls are made of porcelain biscuit, and the department in which they are manufactured takes rank with establishments for the production of stoneware. We first pass through a vast shed containing a large number of tubs filled with kaolin designed for moulding thousands of dolls' heads. The paste taken from these tubs is kneaded, passed through rollers, and made of the desired thickness, according to the size of the head to be manufactured (there are dolls that exceed a four year old child in stature), and then the paste is cut into squares and placed in a mould in the form of a mask. This work is very rapidly performed by women.

After the heads have remained in the moulds a sufficient length of time, they are taken out and dried in a special room (Fig. 1, next page). In this same room, female operatives place a mould over the dolls' heads and form the apertures into which the glass eyes will be inserted later on.

After the porcelain heads have been thus fashioned, they must be baked just like any other object made of the same material. To this effect the heads are laid alongside of each other in earthen seggars, and the latter are piled up in a vast furnace, wherein the heads are baked for twenty-seven hours. This done, the heads are allowed to cool, and are then sandpapered in order to give them a perfectly smooth and polished surface.

This is the first stage in the manufacture—that of the porcelain—but the heads are not yet finished. We now enter a second part of the factory, in which no less than three hundred and fifty male and female operatives are employed. This is the department in which the porcelain is decorated or painted (Fig. 2, next page). Each woman, seated before a small table, has in front of her a series of dolls' heads, some colors and brushes, and busies herself in painting the eyebrows of the doll. In another room the lips and cheeks are painted. It takes several coats for each tint.

When the painting is finished, the heads are placed in a furnace of a lower temperature than the one in which the kaolin was baked, and are allowed to remain therein for seven hours. The heads are then finished.

In the room where the eyes are made, twenty girls are busy melting glass rods with the blowpipe, and acquire themselves of their task with wonderful skill. There are eyes large and small, according to the size of the head, and colored according to the hue of the hair, for there are blond dolls and brunette ones. The eyes go to another room, where workmen fix them in their sockets with wax. There is also a complementary

manufactory, that of the mechanism that is adapted to the eyelids and permits the doll to open and close its eyes.

The manufacture of the doll's body is no less interesting than that of the head. Each part of the body—bust, legs, arms, and hands—is fashioned in a cast iron mould in which women superpose pieces of paper covered with glue (Fig. 3, next page). The paper is packed in the moulds with small wooden tools, and when it is taken out is found to be converted into some part or other of the body.

whitened, they are put aside to dry, and then they pass to other rooms, where they are painted flesh color. Five coats of paint are applied in succession, and then a coat of varnish is put on and allowed to dry.

We now come to the adjusting, which consists in uniting the limbs and fixing them by means of *cuvettes* and strong rubber loops that permit of the articulation of the limbs. The elastic of the leg is passed into the thigh and connects with that of the middle of the body, where it is fixed to an iron hook that occupies the entire breast; and so for the forearm.

The doll is now complete, save the head. A hook is adapted to the shoulders, where it is fixed by means of a strong wooden frame (Fig. 4). This hook passes into the neck, which is screwed so that the doll can turn its head.

Nothing remains now but to add the hair. The back of the head is provided with a piece of cork to which the brown or blond wig is affixed. These wigs, too, are made in departments that are no less interesting than the other parts of the Montreuil factory.

But we must limit ourselves, so as not to tire our readers. We shall say nothing of some of the other departments, especially the one in which are manufactured the parts of talking dolls that say "papa" and "mamma." These are trade secrets that we do not wish to be indiscreet enough to reveal.

Is that all? No. Here we have the large shipping room. (Fig. 5). An elegant little chemisette is put on each doll, and the latter is inclosed in a pasteboard box, from which it will come forth only at the cry of joy of the little mamma who is to dress it.—*La Nature*.



FIG. 4.—SETTING THE PORCELAIN HEADS.



FIG. 5.—SHIPPING ROOM.

DOLL FACTORY AT MONTREUIL, NEAR PARIS.

After the different parts of the body have been moulded, they are placed upon hurdles to dry, then the operation of gluing the limbs is begun. Next, the *cuvettes* are put in place. What are called *cuvettes* in the manufacture of dolls are small disks of metal, cardboard, or wood to which are attached strips of rubber to aid the motion of the arms and legs.

When the different parts of the body are glued, they are sent to be painted. A thick coat of zinc white is first passed over the cardboard, and nothing is more interesting than to see the room wherein this operation is performed, every woman holding in her hand a large brush with which she paints the limbs of the babies, large and small. After the legs and body have been

defeated the object. Any practical man can understand that if a grain of wheat is broken in two parts and then rolled around in loose dirt of any kind, the dirt will adhere to the flour-exposed portions with such tenacity that it cannot be removed, and forever afterward, if ground in that condition, it becomes a part and parcel of the flour, to the great disadvantage of the latter.

When objecting to cleaning machines that break wheat, no exceptions are made in favor of any kind of machines or cleaning processes that do, no matter what claims may be made for such machines under peculiar or any other circumstances. The principle is wrong, and should not be indulged in. The best scouring ma-

THE IMPORTANCE OF CLEANING WHEAT.

By R. JAMES ABERNATHY.

CORRECT principles never cease to exist, no matter whether applied to milling matters or to other lines of business or conduct. One of the oldest principles, and probably the most written and talked about, is wheat cleaning. Quite early in the history of advanced milling methods the importance of cleaning the wheat well was recognized as a prime factor in securing the best results. Still, then as now, there were many millers who did not attach the importance to that part of the business that they should have done, nor in many instances do they yet. It is a very serious mistake, no matter what the system of milling may be, not to have the wheat as well cleaned as it is possible to clean it. The better the wheat is cleaned, the better the color of the flour will be; and as color is the prime object, then that which will enhance color certainly should be considered of prime value.

Good judgment should be exercised in the selection of cleaning machines, and no machine that in the slightest degree breaks the wheat and exposes the flour should be used, because breaking the wheat and exposing the flour

chines are those that rub close and easy. No miller need be afraid of scouring his wheat too much, so long as he does not break the bran. Three or four operations through any good machine, or a continuous run through three or four good machines, would in no case do harm, but invariably good. As to the kind of machinery, it matters but little so long as the work is well done. Formerly I was considerably impressed with the value of brush machines as scourers, but latterly I have some doubts as to the advisability of using them, not that they will not do some work, but I think a good and easy close scourer will do much more and better work, and therefore I conclude that the expense of a brush machine would better be put in a close scourer. And if only prepared to put in two machines, instead of making one a brush machine and the other a scourer, I would advise putting in two close scourers, as the cost is less and the work more effective. I would not object to putting in a brush for a third machine.

Scouring is not all there is of wheat cleaning. Before being scoured, the wheat should be very thoroughly separated. Wheats, sticks, straws, seeds and other like impurities should all be removed from the wheat. For that purpose good separators should be used. Mills of large capacity and ample means should have both a warehouse or receiving separator and a milling separator. All wheat should be passed through the warehouse machine just as soon as it is received at the mill

be practical advice to enable millers to fit themselves for good cleaning. Whether they are followed or not, something must be done to insure good cleaning, or else the flour will suffer in consequence.—*Milling World*.

LATENT COLD.

ONE of the instructive incidents of the recent blizzard in New York was the attempt of many persons to thaw the snow drifts in front of their houses by building fires in them, and their ludicrous surprise at the failure of the experiment. Our worthy mayor, who knows better than that, urged the proprietors of steam boilers to turn jets of steam upon the drifts, as a public-spirited contribution to the work of clearing the streets—a more effective but still not inexpensive method, as the following calculations will show. The principles of specific and latent heat are not changed when we apply them to what may be called latent cold.

The specific heat of snow or ice is nearly that of water; that is, it requires about the same amount of heat to raise the temperature one degree. But the latent heat of fusion is 140; that is, it requires 140 pounds of water losing one degree in temperature to change one pound of snow or ice at 32° F. to water of the same temperature; or one pound of water at 172° F. added to one pound of snow at 32° (or "just ready to thaw") would barely melt it, producing a total mass

effect. There is no penetration of the heat into the mass of snow—only a surface action between the rapidly moving flame and the snow walls. The specific heat of the gases of combustion is about 0.35 as compared with that of the snow. In other words, they must cool four degrees to warm the snow one degree. Their specific gravity is $\frac{1}{10}$ that of the snow; hence they expose but a small weight to its cooling action. In fact, one may see, in such a snow furnace, the flame actually curling about the projections of the interior surface, without melting them. The conditions are too variable and complicated for a detailed calculation; but the very small stream of water which trickles away from the whole apparatus, to the disgust of the attendant small boy, tells the whole story.

An enthusiastic inventor produced, during the late climatic unpleasantness, a coal oil blow-pipe, which was to be attached to the front of a horse car, and to fuse the snow on the sides of the track as it passed. He declared that he could in this way clear about a mile in half an hour. But a calculation of the total calorific capacity of the oil he proposed to consume showed that it would take him some two months of steady blowing to perform the job; and the authorities to whom he applied wisely concluded to rely on shovels and carts and sunshine.

To return for a moment to the use of steam, it may seem that 35 pounds of coal consumed to thaw a ton of snow is not very much, but it must be remembered that this rests on the assumption that all the steam is thoroughly utilized, and none of it escapes into the air as steam. This, however, can only be secured by special arrangements. In one case, following the New York blizzard, it was found necessary to shovel the snow into a box, at the bottom of which the steam was introduced. But if it must be shoveled anyhow, why not shovel it into carts and haul it away?

Finally, the most serious practical difficulty of all arises from the fact that the product of such thawing is inevitably water at 32°, or "just ready to freeze."

If the weather is sufficiently cold, or the escaping water encounters surfaces below 32° in temperature, it will regerate into a more or less solid mass, and flow no further. The only way to secure the complete removal of the thawed snow is to add fresh steam or hot water to the stream, so as to bring it and keep it well above freezing point. On the whole, the removal of snow drifts by means of steam is not likely to take its place among the great improvements of the century.—*Engineering and Mining Journal*.

HIGHLY VOLATILE LIQUIDS FOR PROPULSION.*

By Mr. A. F. YARROW.

IN dealing with the present subject I propose simply to describe a launch propelled by means of a highly volatile hydrocarbon, which mode of propulsion is, I believe, for the first time brought before the notice of this Institution; and therefore I hope it may be of interest.

We have lately completed the launch represented by the diagram accompanying this paper. The boat is 36 ft. in length by 6 ft. beam, and is built of steel. The hull weighs 14 cwt. and the machinery 6 cwt., making a total of one ton. As regards the hull, there is nothing which calls for special remark. The propelling machinery, it will be seen, is placed at the stern, and consists of an ordinary direct-acting inverted engine, provided with the usual link motion, feed pumps, etc. The vapor generator is placed immediately aft of the engine, and consists of a copper coil inclosed within a double sheet iron casing, the intermediate space between these casings being filled with asbestos. Below the coil is an iron pipe bent into the form of a ring, perforated with holes, and arranged as in a Bunsen burner, so that a mixture of hydrocarbon and air can be forced into it, and ignited on issuing through the holes.

In the bow compartment, and of a capacity of 40 gallons, is placed an air tight copper tank for containing the hydrocarbon, care being taken that the bulkhead aft of it should be perfectly water tight, so as to avoid any possibility of the liquid finding its way into the central portion of the boat. The tank is placed in communication with the feed pumps by means of a pipe passing outside the boat close to the keel. The feed pumps deliver into the bottom of the vapor generator previously alluded to. The exhaust from the engine passes into two condensing pipes placed longitudinally one on each side of the keel; these pipes deliver into the tank, this being a somewhat similar system of condensation to that frequently adopted in steam launches for the sake of retaining the fresh water when working at sea. There are two hand pumps, the one on the port side having its suction in connection with the tank, and its delivery joining the delivery pipe from the pump on the engine. Thus by working this hand pump the hydrocarbon can be drawn from the tank and forced into the bottom of the coil. On the starboard side is the other hand pump, which forces air into the top of the tank; this becomes charged with vapor and passes back through a pipe carried along the gunwale to a supplementary burner placed below the vapor generator, and arranged to ignite the main burner previously described immediately it comes into operation. In order to start the launch, the air pump is first worked by hand, and as soon as the air charged with vapor finds its way to the supplementary burner, it is ignited by means of a taper and heats the copper coil; the air pump is maintained steadily working for two to six minutes, according to the temperature of the coil and its surroundings. When the copper coil has in this manner been warmed up, a few smart strokes are made with the hand pump on the port side, and the liquid from the tank is forced into the coil; immediately the gauge indicating the pressure within the coil will be found to rapidly rise. Then a communication is made by opening a valve between the upper part of the coil and the main burner, allowing a small quantity of the vapor to pass into the burner, together with a suitable amount of air, which is drawn in with it, and on issuing from the holes is immediately ignited.

When this has been fairly started, the air pump is not further needed, and so long as the pressure is maintained in the coil, the flame will continue. The en-

* Read at the Institution of Naval Architects, March 22, 1888.



FIG. 1.—ROOM FOR DRYING THE DOLLS' HEADS BEFORE BAKING, AND FOR CUTTING THE EYES.



FIG. 2.—DECORATING ROOM—PAINTING THE DOLLS' HEADS.



FIG. 3.—ROOM IN WHICH THE PARTS OF THE DOLLS' BODIES ARE MOULDED.

DOLL FACTORY AT MONTREUIL, NEAR PARIS.

and before it is consigned to the storage bins. By that means the coarser materials, such as sticks and straws and a good deal of dust, are taken out, leaving the wheat in much better keeping condition. Some millers have found it quite profitable to have a receiving separator so arranged as to run the farmers' deliveries of exchange wheat through it. By that means they escape paying for much of the dirt and get a fair return for their money or flour as the case may be. The farmers will kick about it for a while, but they soon get used to it and become honest in their designs and do not try to sell so much dirt.

The mill separator is used for removing oats, seed, and other foreign impurities which the receiving machine fails to catch. No mill should be without a mill separator, and if two can be afforded, so much the better. The better the work done by the separator, the better chance will the scourers have to do a thorough job, because it is easier to scour pure wheat than it is to scour a mixture of wheat, sticks, and weeds. Small mills, that cannot afford to put in two separators, can have this mill separator made with adjustable sieves, and have one set of sieves coarse for receiving, and the other set fine, for cleaning before going to the scourers. It takes but a few moments to interchange the sieves, and, if the machines are provided with a tight and loose pulley, there is never any trouble or loss of time attached to it. The above suggestions are intended to

of water at 32°, or "just ready to freeze." If we assume the water to be used in the most effective way, namely, as steam at 212° F., injected into the mass of snow, and giving up its surplus heat in the most complete and rapid manner, we shall find that the latent heat of the steam, set free when it condenses to water, is an important factor; so that one pound of water, in steam at 212°, would, in condensing and cooling to water at 32°, convert into the same condition a little over eight pounds of snow.

The consumption of fuel required to produce one pound of steam at 212° from water at ordinary temperatures is in practice about one-seventh of a pound. Hence we may say that the melting of a ton of snow would require the combustion under the boiler of at least 35 pounds of coal.

Snow produces, when melted, from one-fourth to one-eighth of its bulk in water, according to the degree to which it has been compacted before melting. Taking one-fifth as a rough mean, we may estimate the weight of a snow drift at 12.5 pounds per cubic foot, or 100 cubic feet per ton. A drift 25 feet long by 10 feet wide and averaging 4 feet in depth would contain 6½ tons; and the steam to melt it would require the consumption of 233 pounds of coal.

It may now easily be seen why the burning of small bonfires in snow furnaces, most of the heat of combustion going up the snow chimney, produces so little

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gine can now be started, the main feed pumps at once taking the place of the hand feed pump, which can be stopped. From this moment the action throughout will be automatic, and when once started neither engine nor boiler requires any further attention. A working pressure in the launch to which I make reference can easily be maintained at about 70 lb. per square inch.

After the vapor has left the engine it passes through the exhaust pipes, is condensed, and forced by the engine back into the tank, where it arrives in its original fluid form. As a matter of fact, from our experience, the boat can run at a speed of from seven to eight miles an hour for several hours without any attention whatever being required, excepting only occasionally lubricating the bearings. It will at once be seen there are several very important points in which this system is superior to steam. On an average, in this climate, the time required to start the launch at full speed from lighting up does not exceed five minutes. The entire central portion of the boat is available for passenger accommodation, which may be roughly estimated as not far from doubled when compared with steam.

There is a very large saving in weight of machinery, owing to the very small size of the vapor generator, as will be clearly seen from the diagram, which is drawn to scale; in fact so light is it that two men can easily lift it. Further, this reduction in weight renders lighter scantling of hull admissible. The small weight of the launch is very apparent when it is remembered that it weighs only a ton, machinery included. The fuel supply requires no attention whatever, being perfectly self-acting, all hand firing being abolished. And owing to the absence of coal, the whole arrangement is extremely cleanly. Also, one person, with ease and comfort, can take entire charge both of the steering and management of the machinery. To stop the boat, all that is necessary is to cut off the supply of vapor, and no further attention is required.

With a view to identify this class of launch, we distinguish it as the "Zephyr type." Touching the first cost, it practically remains the same as if steam were used; and as regards the expense of working, from the experiments we have made, a speed of seven to eight miles an hour requires a consumption of hydrocarbon of about one and a quarter gallons per hour. The hydrocarbon used is one of the early products in the distillation of petroleum, having a specific gravity of from 0.725 to 0.730. This liquid is an article of commerce in the United States, and can be purchased there at the rate of 5d. per gallon. It will be seen from the description that the vapor consumed is practically that which goes to the burner, since that which performs work in the engine is exhausted into the condensing pipes running along the bottom of the boat, and is forced back to the tank to be used over and over again; consequently, if expense be an object, a cheaper liquid can be used for heating purposes.

As it may be a matter of interest to the meeting to know the amount of heat required to evaporate this hydrocarbon when compared with water, I have had a diagram prepared to illustrate it, based upon experiments carried out by Messrs. Johnson & Sons, and representing the heat required to evaporate equal quantities by measure of water and hydrocarbon respectively, the latter requiring much the smaller. As to the thermo-dynamic value of the new system, we are making experiments with a view to ascertain what benefit, if any, is obtainable. Touching the durability of the arrangement, there has not been sufficient time to arrive at any data; but owing to the extreme simplicity of the generator, and as there is no sediment deposited by the liquid, and as the temperature at which evaporation takes place is very low, there is every reason to expect that the generator will be vastly superior in point of durability to a steam boiler. To illustrate the low temperature at which evaporation takes place, I may mention that when running at full speed it is quite possible to place one's hand directly over the funnel without inconvenience.

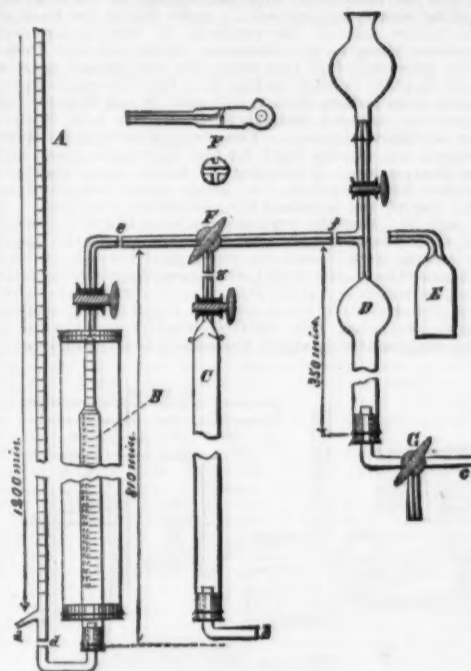
AN IMPROVED FORM OF GAS APPARATUS.

By J. T. WILLARD.

THIS apparatus was constructed for use in the chemical laboratory of the State Agricultural College of Kansas, and was used in an examination of the natural gases of that State by Prof. G. H. Failyer. As it embodies some advantages not combined in any other apparatus that has come under the notice of the writer, a description of it may not be amiss. It is essentially a combination of Elliott's apparatus and Frankland's apparatus for the analysis of gases incidental to water analysis, with important modifications and additions. The accompanying cut will make its construction clear.

A is a pressure tube graduated in millimeters. B is the measuring tube holding about 120 c. c., 100 c. c. of which is graduated to tenths, beginning with the stopcock, F. Its upper part is narrow, thus admitting accurate measurement of small amounts of gas as well as large. It is inclosed in a water jacket which must be provided with some means of securing a uniform temperature throughout. G is the explosion tube, and is ungraduated. D is the absorption tube, surmounted by a funnel for the introduction of reagents. E is a laboratory vessel of the ordinary kind, which may be attached instead of D if desired. It is obvious that any form of absorption pipette may be attached at f. B, C, and D are connected by the stopcock, F, a four-way cock shown in section above. By means of this cock, the others being suitably arranged, either tube may be put in connection with either of the others or with the external air without disturbing the other tube or tubes. G is an ordinary three-way cock. Reservoirs not shown in the cut are attached to the tubes by means of rubber tubing at a, b, and c. The ends of the tubes are closed by rubber stoppers, and the several parts are connected by heavy rubber connectors at d, e, f, and g. The ends of the capillary tubes are ground squarely at these joints, so that they come together perfectly. The apparatus is firmly attached to a suitable support, such as any one with a little ingenuity may devise. It is essential that A and B be so supported that their relative positions shall remain unaltered. The apparatus was designed for use with mercury, but water may be used. With water the pressure tube would be unnecessary.

Concerning the mode of operating the apparatus, but little need be said. It is most convenient to use Frankland's method of measuring, in which the gas operated upon is always brought to the same volume, or to an aliquot part of the original volume, by adjusting the pressure of the mercury in A. Points on the pressure tube corresponding to a number of convenient volumes in the measuring tube must be previously determined with care. The tensions exerted by varying amounts of gas brought to the same volume will be proportional to the amounts of gas present. If the gas is brought to an aliquot part of the original volume, the tension



found may be reduced to that corresponding to the original volume by a very simple calculation.

The explosion of the gases is performed under reduced pressure, according to the principles developed by Thomas.* This method of explosion is very advantageous, and may be used with this apparatus, even if water is used in the tubes, B and D, by filling C with mercury. On lowering the reservoir connected with C, any desired degree of rarefaction may be produced. It is convenient to have a rough scale back of C and extending below, for use in measuring the pressure under which the gas is confined during explosion.

The fourth way in the stopcock, F, is essential for the discharge of the reagents employed in D; it is also used for the introduction of the gases. If it is desired to preserve a portion of the gas in D while another portion is being measured and exploded in B and C, it is necessary to close this external opening of F. This may be done simply and perfectly by filling the way with water or mercury from one of the tubes, and then slipping a short piece of rubber tubing filled with water over the end of the stopcock and closing it with a clamp.

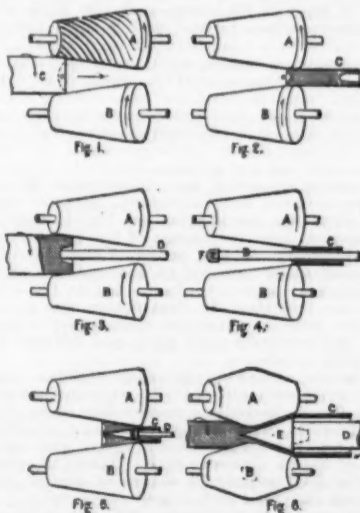
I think no other details of manipulation need be entered into, as they are similar to those already described for other apparatus, or can be readily worked out by the operator.

The apparatus may be used for certain of the purposes to which the nitrometer has been put, such as the valuation of bleaching powder by hydrogen peroxide, and vice versa.

The apparatus described was made in most excellent manner by Mr. Emil Greiner, of New York.—*Amer. Chem. Jour.*

A NEW METHOD OF ROLLING TUBES.

FOR some time past, German rolling mill engineers have been discussing the probability of success of the new method of rolling tubes, which has been invented



by Herr Reinhard Mannesmann, of Remscheid; but as the inventor has as yet not suffered the details of his process to become publicly known, no very definite opinion could be formed in technical circles. Some engineers here expect the new process to completely revolutionize the rolling of tubes and articles of this

kind, while others will only allow the invention a very limited sphere of application, and Herr Martin Balcke, in a paper recently read before the Society of German Engineers, even goes so far as to condemn the new system altogether. This criticism is based on the supposition that the tubes produced by the new process are weaker than welded tubes, and that an excessively large amount of power is required to drive the new rolling mill. It need hardly be said that both objections are purely conjectural. Where opinions are thus divided, some definite information on the subject will probably be of interest to the readers of *Industries*, and with a view to lay the facts before them, I recently paid a visit to the works of the inventor, and inspected the new rolling mill and some tubes made by it. The invention is protected in Germany by patent No. 34,617, but the specification is so vague that no definite idea as to the details of the invention can be formed from a perusal of its contents. In the German patent the inventor claims to be able to roll in a single pass all kinds of sections, including tubes with ribs and other projections; but, as a matter of fact, he has up to the present confined himself to the rolling of straight tubes only. The American patents are more definite, and the sketches which accompany this description are reproduced partly from the American patent specification. The numbers of the American patents are from 361,954 to 361,963.

The only rolling mill on the new plan which has yet been built and practically worked is a small one at the works of the inventor in Remscheid. I have seen tubes of various diameters, and up to 10 ft. in length, rolled by this mill without a mandrel out of solid blocks of Bessemer steel, Thomas steel, and Delta metal. All the samples were perfect in appearance, and to judge from the manner in which they can be bent and the edges flanged over, the strength of the tubes is certainly greater than that of ordinary welded tubes of the same dimensions and materials. The success achieved with this experimental mill has induced one of the largest German tube works (Ponsgen, of Dusseldorf) to adopt the process, and to set apart a portion of their works for the rolling of tubes on this system. A large rolling mill on Mannesmann's principle has been there erected, and will be driven by a large engine of 800 horse power, running at 150 revolutions per minute. A second installation on the same system is in course of erection at a tube works in Saarbrück, and a third in Komotau (Bohemia). These facts will show that the new process is of practical importance, notwithstanding the adverse criticism of some German engineers.

The principle on which the action of the new tube rolling mill is based will be understood from Fig. 1, where A and B are two conical rolls, the axes of which are situated in two parallel vertical planes; but each axis is inclined to the horizontal, so that the smaller end of roller A and the larger end of roller B are uppermost. The rolls are preferably provided with spiral corrugations, although this is not absolutely necessary. In the illustration these corrugations are only shown for the roll A, but it must be understood that all the other rollers shown in the figures may be similarly corrugated. The object of the corrugations is to provide a firmer grip on the block which is being worked. If the rolls revolve in the direction shown by the arrows, and a metal block, C, be inserted between their smaller ends, it will be gripped by the rolls and revolved, while at the same time, owing to the horizontal component of the rotary motion, the front end of the block will be drawn to the right. It is, of course, necessary to guide the block so as to prevent its jumping out from the rollers. This can be done either by separate guide rolls or by placing a similar pair of inclined working rolls above and below the block. For simplicity of illustration the guiding arrangements are omitted. The effect of the rotary and forward motion imparted to the fibers of the material is to draw them out spirally, whereby the metal is taken from the interior of the block and transferred to the surface. The drawing-out action on the surface of the block is greatest at the front end, where, owing to the larger diameter of the rolls, the speed is greatest, while at the same time the rear end of the block is prevented from following equally fast by the conveying surfaces of the rolls.

At the beginning of the process a cavity, C, is thus formed, and as the block advances the diameter decreases while the cavity extends, so that when the whole block has passed through the rolls it presents the appearance of a tube open at the forward end, but closed at the rear end, as shown in Fig. 2. A small cavity, c, is also formed at the place where the tube leaves the rolls. A tube is thus formed out of a solid block in one pass, and the dimensions of the finished tube depend upon the form of the rolls, their distance apart, and the inclinations of their axes. It will be seen that this process of rolling tubes is fundamentally different from the ordinary method. In the latter the rolls revolve in opposite directions, so that their working surfaces where they come in contact with the block have the same direction in space, and the block passes at right angles to the axes of the rolls, which are parallel. In this new mill the rolls revolve in the same direction, and their working surfaces, where they are in contact with the block, travel in opposite directions, imparting to the latter a rotary movement, while the block advances approximately parallel to their axes. It is also evident that with this system the tubes can only be open at one end, since the tubular formation must cease as soon as the retarding influence of the conveying surfaces of the rollers on the rear end of the bar ceases. If it be desired to obtain tubes open at both ends, it is necessary to employ a mandrel, as shown in Fig. 3. In this case the block must be well heated before being put between the rolls. The mandrel has the effect of keeping back the center portion of the block, especially toward the end of the pass.

The illustration represents the moment when the tubular formation has begun, and the bottom of the cavity has come in contact with the end of the mandrel. The other end of this mandrel is supported in a foot step or thrust bearing, so that it can revolve with the block.

In some cases a detachable head, E, is attached to the mandrel (Fig. 4), and when the pass is finished a small quantity of metal, F, is generally torn off the rear end of the tube. If the material to be operated upon is very ductile and soft, previous heating is not required, and in that case a mandrel, D, with a pointed head, E (Fig. 5), is used. The rolls, A and B, then act partly as

* *Journal Chem. Society*, 21, 106.

* *Jour. Chem. Society*, 33, 213.

faced rollers, which push the block, C, over the end of the mandrel. The same apparatus may also be used to reduce the thickness of tubes previously rolled, as above described. The inner diameter is then determined by the size of the mandrel head, while the outer diameter depends upon the distance between the larger ends of the rolls. For certain very soft materials the inventor finds it advantageous to assist the feeding motion of the rolls by providing the mandrel with a screwed head and revolving it by power. In this case the material is fed from the inside as well as from the outside, and the fibers are arranged spirally throughout the length of the tube. In all previous arrangements the size of the finished tube is smaller than that of the original block; but where it is required to produce a tube of larger diameter than the block, Herr Mannesmann adopts rolls of the form shown in Fig. 6. In this case one half of the rolls act as shown in Fig. 1, while the other half simply serve to enlarge the tube thus formed. The material is also in this case fed forward by the horizontal component of the surface motion of the rolls, and the tubular formation begins slightly before the middle is reached, where the diameter of the rolls is greatest. From that point the metal is spread out by the insertion of a mandrel with a conical head, and thus a tube of larger diameter than the original block is produced.—*Industries.*

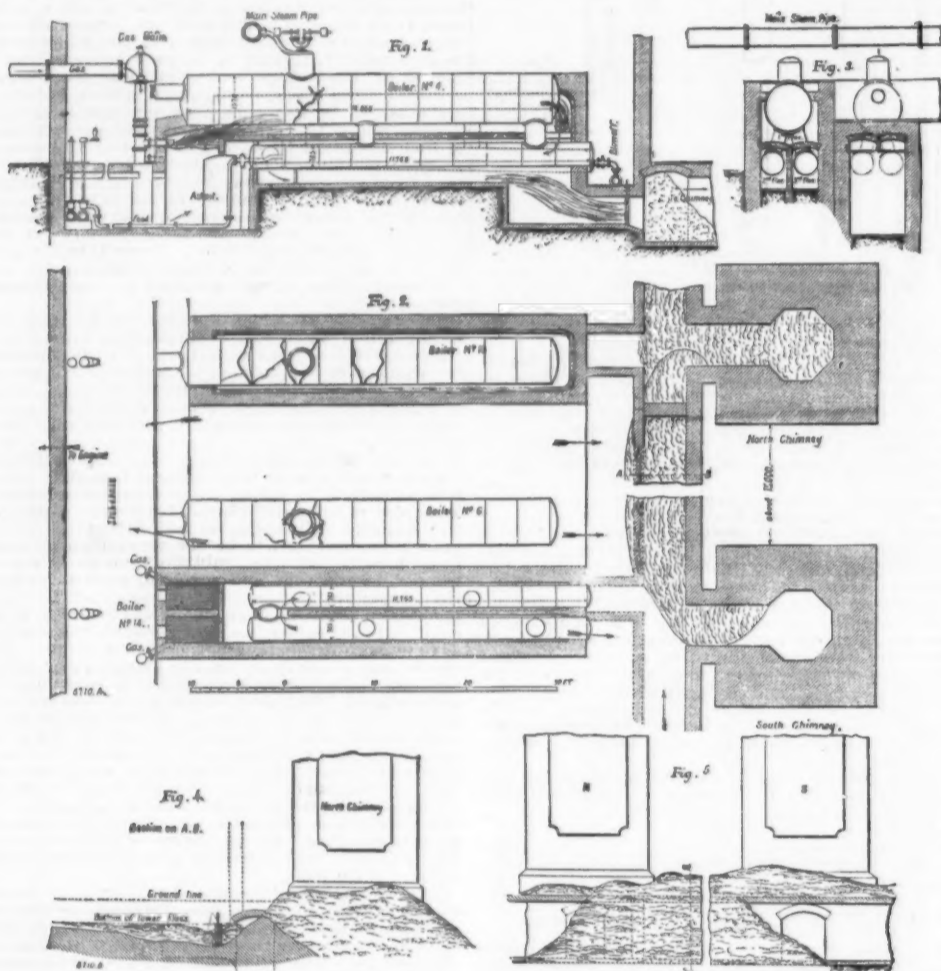
BOILER EXPLOSION AT THE FRIEDENSHUTTE.

PROBABLY the most wholesale and disastrous destruction of steam boilers on record, says *Engineering*,

however, was somewhat more brittle than any steel now used for boiler construction. The larger barrels were built of plates $\frac{1}{2}$ in. thick, the smaller of $\frac{3}{8}$ in. plates, while the necks were of $\frac{1}{2}$ in. plate. The boilers were worked up to 75 lb. pressure. A grate of 37 square feet surface was provided under the front end of the large barrel in each boiler, and on it was burned from 2 lb. to 3 lb. of dust coal per square foot of grate surface per hour, this fuel simply serving the purpose of keeping the blast furnace gases, which served as the real fuel, alight, these gases being rather difficult to burn.

From our illustrations, Figs. 1, 2, and 3, the course of the gas before and after its passage over the grate will be clearly understood; a main flue at the back of the boilers collects the products of combustion and conveys them to the chimney. There are two chimneys provided, and the main flue has simply a cross wall in it as marked in Fig. 2, so that the combustion gases from boilers Nos. 1 to 7 and 23 and 28 enter the northern chimney, and those from Nos. 8 to 20 into the southern chimney. The steam generated by these boilers was chiefly used for the blowing engines, and for the purpose of keeping the works going eighteen boilers were required, four being always idle, and on the day of the accident the idle boilers were Nos. 1, 3, 6, and 20. But the explosion appears to have affected all of the boilers to a nearly equal degree: the upper cylinders were blown to pieces and thrown to long distances in a somewhat regular and systematic fashion, to which we shall refer later on, while nearly all the lower cylinders remained in or near their original positions, being only shifted lengthwise. Owing to the comparatively small amount of fuel burned—only

The investigation of the explosion, which was carried on by delegates from the various boiler inspection societies of Germany, appears to have been a very careful and detailed one. The question of over pressure naturally received considerable attention; an accumulation of steam would take place if the blowing engines were stopped, although this would also in turn have the effect of reducing the quantity of blast furnace gases supplied to the boilers, and thus check the production of steam. Against the theory of over pressure there is abundant evidence. Three attendants were on duty, and must of necessity have noticed the pressure rising; there were thirty-six safety valves, which ought all to have blown off, and by simply turning the gas supply valve a further rise in pressure would have been prevented. Superheating and weakening of plates in consequence of low water is equally unlikely, the feed system of the boilers being connected; if one pump failed, there were several others to make up for it; moreover, it would take considerable time for the water to get dangerously low in a large under-fired cylinder, and although blue patches were discovered on some plates belonging to boilers 6, 7, and 12, they were unmistakably due to local superheating in consequence of the accumulation of incrustation; specimens taken from plates with blue patches and broken showed, moreover, no signs of overheating in the grain of the metal. Besides, in gas-fired boilers, overheating of plates is not nearly so likely to occur, since "furnace plates," in the generally accepted meaning of the term, do not exist, especially where the gas is of such composition that it is, as in this case, difficult to ignite. Frequently the gas in these boilers had been observed to burn throughout the whole length of the boiler flues and in the main flue, and the flames were often seen to issue from the chimneys, according to the admission of air by the furnace doors. This peculiarity frequently causes the various parts of the boilers to be exposed suddenly to great differences in temperature, and consequent unequal expansion and working in the circumferential seams, cracks occur suddenly, often so slight that they are hardly visible, yet none the less dangerous, if extending from rivet to rivet in the seams; and in plates which, like those of the Friedenshutte boilers, are of inferior quality, such cracks are likely to sooner or later lead to serious consequences. The general type of these boilers also appears to be rather liable to destruction, since during



occurred at the Friedenshutte, in Upper Silesia, Germany, between 12 and 1 o'clock on the morning of July 25, last year, when twenty-two boilers, of over 1,000 square feet of heating surface each, were at one moment blown to pieces; the boiler house, covering a space of over 15,000 square feet, and adjoining buildings, were utterly destroyed, and the only three men in charge killed.

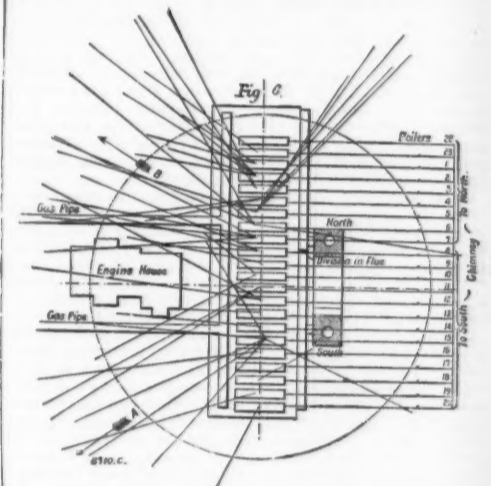
That so exceptional a destruction of steam boilers should attract considerable attention and set everybody to work to discover the causes of this unique accident will be readily understood, and reports have been prepared by the engineers of several Prussian boiler inspection societies, weighing carefully all points *pro* and *contra* of any particular theory that might be advanced, but the final conclusion of all appears to be that what had at first been looked upon as a boiler explosion, as it is generally understood, in which the destructive agent is the pressure within the boiler, was in reality a disaster of another kind. In fact, the available evidence seems clearly to indicate that this unequalled destruction was occasioned in the first place by an explosion of gases in the boiler flues, aided no doubt in its terrible effects by the steam set free in consequence of the boilers having been damaged. To enable our readers to more fully enter into the points of this case, we will describe the plant, of which we give some illustrations.

The boiler plant consisted of twenty-two boilers of the so-called elephant type—that is, with three cylinders united by connecting necks, as shown in Figs. 1 and 3. The larger upper cylinder is 40 ft. 3 in. long and 5 ft. 2 in. in diameter, while the lower two are each 37 ft. 7 in. long and 31 in. in diameter. The latter are connected by one neck near the front end, and each is joined to the main cylinder by two short necks, as shown in Fig. 3. The boilers were for the most part built in 1872, of what was then called mild steel, which,

about 20 tons in 24 hours—and the little attention otherwise required by the boilers, two firemen and one assistant only were required, and these three met, as we mentioned before, with probably instantaneous death on the occurrence of the accident, so that no information could be obtained of anything that might have taken place just previous to the explosion. In the official report of the Centralverbandes preussischer Dampfkessel-Überwachungsvereine, to which we are indebted for our information, it is stated at the outset that in respect of general arrangement, management, supervision, and inspection, no fault was to be found with the installation at Friedenshutte. The investigation into the causes of the accident was rendered extremely difficult, owing to the absence of any evidence of an eye witness or the report of an inspector at the time of or even hours before the explosion, and to the fact that the destruction was so complete that the boilers could not even be built up of the pieces, and in many cases parts and fittings have not been found at all.

The whole of the steam spaces of these twenty-two boilers were connected to one large main steam pipe placed above the boilers, each boiler being, of course, shut off by its own 6 in. stop valve, and being provided with self-acting return steam valves and two safety valves of 3½ in. diameter each. There was ample provision for feed supply by means of pumps, and each boiler was provided with a feed check valve.

It appears that in March, 1886, one of the circumferential seams on one boiler was torn, and careful examination then revealed that the plates were of inferior quality; in consequence of this quite a number of plates were, at the request of the Schlesischen Inspection Society, replaced by others of good quality; and, during 1886 and 1887, twenty-one of these boilers were subjected to the hydraulic tests of 150 lb., and were found satisfactory.



the years 1877 to 1886, out of a total of 155 boiler explosions in Germany, 57 occurred on boilers of this same type. Fortunately less boilers of the type are used now than formerly.

Looking at the general plan of the boiler house, Fig. 6, and following the line of flight of the exploded boilers indicated thereon in lines, it will strike the observer that there is a decided system in all this remarkable destruction, and it was this fact which attracted the attention of the investigators and led to the suggestion that the cause might be other than a boiler explosion proper. Somewhere between the two chimneys, near the middle of the row of boilers, seems to have been the center of the destructive action, this extending along in the line of the main flue from end to end. The upper parts of all the boilers were separated from their lower adjuncts, propelled long distances through the air, and all more or less destroyed. The lower cylinders were, on the contrary, to a considerable extent intact, some had broken seams, of course, yet the lower cylinders could in each case be identified, and were found in or near their original position. This then decidedly pointed to the explosive agent having exerted its force between the upper and lower boilers, propelling the upper with great violence, but merely pushing or crushing the lower. The only agent that could have acted in that manner was gas, accumulated in the flues and suddenly ignited, exploding with great force, destroying the boiler settings, tearing up the ground, and throwing the upper boilers right away, as though they were shot from a cannon. The mixture was, no doubt, one of furnace gases, coal gas developed by incomplete combustion, and air, a highly explosive mixture, which, accumulated in sufficient quantity, only needed ignition to fully account for this remarkable explosion.

The action would probably be as follows: During the night dinner hour, between twelve and one, the men do not wish to be disturbed any more than is necessary, and they would charge a larger quantity of damp dust coal upon the grate; this charge might almost completely damp the fire, leaving no flame, but favoring the production of gases of distillation. The furnace gas supply would remain the same as usual, air entering through the open fire door in suitable quantity, but the furnace gases not being ignited upon the grate, would travel with the others, mixing as they turn corners, and finally meeting either with brick work sufficiently hot to ignite them or flames from other adjoining boilers. The explosion, which would most likely take place in the rear end of one or more of the boilers, would sever the connection between

the upper and lower cylinders, and the sudden release of a large volume of steam would readily come into action to complete the work of destruction, in a manner which would have a result closely resembling that of the actual case at Friedenshutte.

In the official report, which forms the basis of our article, it is shown at considerable length that even without the theory of an admixture of furnace gases and coal gases, an explosion is quite probable under certain conditions, and Mr. W. Lurmann, of Osnabruck, is quoted to have said that it is never advisable to burn blast furnace gases and coal under the same boiler. The probable composition of the gases is given by weight as :

	Per cent.
Nitrogen.....	64.8
Carbonic oxide.....	33.8
" acid.....	1.3
Hydrogen.....	0.1

This is for coke blast furnace gases, when taken at about two-thirds the height of the blast furnace. A mean of fifty analyses of blast furnace gases at the Barbacherhutte is given as :

	Per cent.
Nitrogen with varying quantities of water.....	50 to 60
Carbonic oxide.....	24
" acid.....	12
Hydrocarbon.....	4

The greater quantity of carbonic oxide in blast furnace gases increases their value as fuel, and the gases at the Friedenshutte, where gray Bessemer pig is made, are reported to be rich in carbonic oxide and poor in carbonic acid. About the explosibility of blast furnace gases there can be no doubt, and in all well-arranged gas mains safety flaps are provided in such a manner that in case of local explosions in the mains, the flaps open outward and relieve the pressure. The gas flue up to the boilers at the Friedenshutte were amply supplied with safety flaps.

The representatives of the various boiler inspection societies who have prepared the report before us guard themselves against the conclusion being drawn from this investigation as to the non-suitability of blast furnace gases for use under steam boilers, by saying that in good arrangements, where the constant ignition of the gases is secured, no objection can be raised to the use of furnace gases for boiler heating purposes, and they sum up their report as follows :

"By an unfortunate coincidence, an accumulation of explosive gases has taken place in the flues, and these gases have been ignited. This gas explosion has caused a local destruction of the boilers, probably in the severance of the neck, which could the more easily take place, considering the construction and great length of the boilers and the inferior quality of the boiler material. The gas explosion was the cause of the rupture and ultimate explosion of the boilers."

In conclusion, we have to thank Mr. H. Minssen, of Breslau, one of the experts who investigated this explosion, for supplying us with the report upon which this article is based.

A RECENT IMPROVEMENT IN THE PLATINOTYPE PROCESS.*

By W. WILLIS.

As it is abundantly evident that many to whom the practice of the platinotype process is familiar are unacquainted with the principles upon which it is based, and as, moreover, I am compelled in this paper to make frequent reference to these principles, it will, perhaps, be better to explain them at the outset, in the meantime claiming the indulgence of those to whom they are well known.

The discovery of the reduction of ferric oxalate by the action of light was made, I believe, toward the end of last century. Most photographers are aware that if paper be coated with this salt, ferric oxalate, and then exposed to light under a negative, a visible image will be formed upon it. This image consists of ferrous oxalate more or less mixed with unaltered ferric oxalate. Now, the ferrous oxalate forming this image is a powerful reducing agent, and its reducing action can be made apparent in an easy manner by applying to it solutions of salts of various metals, such as silver, gold, etc. These pieces of paper have been coated with ferric oxalate and exposed to light under a negative. They now exhibit faint images, consisting mainly of ferrous oxalate. On floating one of them in a solution of ammonio-nitrate of silver, you will observe that a blackish image of reduced silver occupies the place formerly held by the faint ferrous image. In the same manner, by floating another piece on a solution of chloride of gold, it will be found that a gold image replaces the ferrous one. Reasoning by analogy, it seems fair to conclude that on applying to a piece of this paper a solution of chloride of platinum in a similar manner an image will be produced in platinum, but on making the experiment it will be seen that such is not the case. Platinum requires stronger and more coercive measures. Now, if we could place some of the ferrous salt forming this image into test tubes, we could more conveniently experiment upon it.

You will observe that we have hitherto obtained this ferrous salt in the form of an image by the action of light upon ferric oxalate, but there is a much simpler method of forming the salt in larger quantities, and entirely by chemical means—namely, by mixing solutions of ferrous sulphate and oxalic acid. This mixture immediately throws down a precipitate of the salt, as a lemon yellow powder. I have here some of the salt thus made, and subsequently washed and dried.

Now, in each of these test tubes is placed a little of this salt, ferrous oxalate. Into the first tube I will pour a solution of silver, into the second a solution of gold chloride, and into the third a solution of platinum chloride. You will notice that a very rapid reduction of the metals takes place in the tubes containing the salts of silver and gold, but no trace of reduction in the third tube, containing the salt of platinum. Even on boiling the ferrous oxalate in contact with platinum chloride, little or no reduction takes place.

In 1873, when making this experiment for the first time, I was greatly puzzled by the obstinacy with which the metal refused to be reduced from the plati-

num chloride. After a time I came to the conclusion that could the ferrous oxalate be dissolved in some solvent, reduction of the platinum chloride would be effected. My efforts to find this were unsuccessful until a note by a French chemist led me to try the neutral oxalate of potash. I had to make this salt. It could not then be procured in London. On trying this salt my expectations were realized, and the platinum was instantly reduced. Into this tube containing ferrous oxalate a solution of potassic oxalate is placed. On heating the solution the ferrous oxalate is dissolved, and now on dropping into the warm solution some platinum chloride, it will be seen that platinum black is thrown down.

This experiment shows that the ferrous salt, which by action of light is formed on paper which has previously been coated with ferric oxalate, if formed in larger quantities by chemical means and then treated in a test tube in the manner described, is capable of reducing a salt of platinum. The problem, then, is to find out how to make the reaction take effect, not only in a test tube, but on paper which bears a ferrous image, and to secure so rapid a reducing action that the platinum shall be reduced by the image before the latter has been dissolved away by the liquid applied. It was by a test tube experiment identical with the one just shown you that the possibility of inventing a platinotype printing process first presented itself to me. Indeed, before my test tube was cool, more than one method of working suggested itself. A note is well placed here. I have suggested that the use of the potassic oxalate is merely as a solvent of ferrous oxalate, and this is the view I undoubtedly held at the time this experiment was made. But I am convinced that this is not its only office. It is, *per se*, a reducing agent, and it very probably acts in increasing the reducing action of the ferrous salt.

Previous to this date, 1873, several processes with iron salts had been discovered by Sir John Herschel and others. In these processes paper was coated with ferric oxalate, citrate, or tartrate, then exposed to light, and then developed in solutions of ammonia, nitrate of silver, chloride of gold, ferrocyanide of potassium, and others. Two of these processes have just been shown to you, namely, those with ammonia, nitrate of silver, and chloride of gold. In all these processes, as far as I am aware, a solution of the salt of the metal in which the image was to be developed was applied to the iron-coated paper after the latter had been exposed to light. I then very naturally attempted my first experiment in platinotype in a similar manner by coating paper with ferric oxalate, exposing it to light, and then developing it in a solution of potassic oxalate containing a salt of platinum. But, except from a scientific point of view, my results were valueless, for I obtained a picture in which only the deep shadows were developed, and these very, very feebly. This is the method which—now made a successful one—I wish to introduce later on. This failure led me to try every conceivable combination of the chemicals and sequence of the operations.

But before proceeding I must here allude to another discovery, but for which platinotype would not have possessed any practical value. All my early experiments were naturally made with platonic chloride (PtCl₄), but by its aid nothing but hard results could be obtained, quite devoid of half tone. It then occurred to me that by using a salt of platonic chloride (PtCl₂) only two atoms of chlorine would have to be removed instead of four atoms, as when PtCl₄ is employed, or, to state it differently, the ferrous oxalate would have less work to perform on PtCl₂ than on PtCl₄. After a troublesome operation, I made some potassic chloro-platinite, a double salt of potassic chloride and platonic chloride, and, by substituting this for the platonic chloride previously used, the results obtained were, as anticipated, full of half tone.

At this stage, in 1873, I had discovered* all the essential elements of all modifications of the platinotype process. These are :

1. Ferric oxalate as a sensitizing agent on which the light acts.
2. Salts of platonic chloride, from which the pigment, platinum black, was to be obtained.
3. Potassic oxalate, which conveniently may be termed the developing agent.
4. Salts of lead and of mercury as aids to reduction.

Now, as I before stated, having failed in the oldest and most natural mode of working, namely, that in which the paper is sensitized with ferric oxalate, exposed, and then developed on a solution containing potassic oxalate and potassic chloro-platinite, I proceeded to try every possible combination. The following are among the methods I tried :

1. Coating with ferric oxalate and platinum salt, exposing to light, and then developing on potassic oxalate.
2. Coating with ferric oxalate, platinum salt, and potassic oxalate, and printing out or developing on hot water.
3. Coating with ferric oxalate and potassic oxalate (or the double salt), and then developing on a solution of potassic chloro-platinite.
4. Coating paper in the same manner as last, and after exposure to light applying to it, under pressure and heat, another piece of paper which had been coated with potassic chloro-platinite, and then allowed to become almost surface dry. By this method it will be seen that the image obtained on the iron paper was used for the purpose of producing an image in platinum on another piece of paper. And many other methods with which I will not now trouble you.

Of these methods, the only one which seemed really promising was the first, for one form of which I took out a patent in 1873. This, however, was a very complicated process, and extremely difficult to work. This method in its perfected form became the method now almost universally practiced.

As these methods, however, lie outside my present subject, I have merely alluded to them as helping to illustrate the historical development of the process. Having now finished the brief sketch of the principles underlying the process, and the earlier methods discovered for working, I will proceed to the main subject of my paper, namely, the new platinum in the bath method. I have already stated that my very first experiment in platinotype printing was by this method.

Its failure resulted from the fact that the ferrous image formed on the paper was dissolved away when treated with the platinum developing solution before it had time to reduce the metal from the platinum salt.

It is evident that to make such a method successful, one of three things must be done—either the reducing power of the ferrous image must be increased, or a developer must be used from which the platinum is more easily reduced, or the ferrous image must be rendered partially insoluble in the developer until the reducing action is complete. In the modification about to be introduced I have effected the desired result by the first named plan, namely, by increasing the reducing power of the ferrous image.

Now, in my note book for 1879, I find the following experiment recorded : "Here success was probably due to the action of the mercury salt in increasing the reducing power of the ferrous image, or by causing the reducing action to take place so rapidly that it was completed before the ferrous image was dissolved away."

Between 1879 and 1886 I find two other records of experiments of a similar nature, and it now appears to me foolish that they were not followed up, but, as a matter of fact, my mind was so prejudiced against this method by the many early failures, that the experiments were almost forgotten. In 1886, however, I again made some experiments in the same direction, which were so successful as to set me to work seriously. In this paper I propose to describe only one form of the platinum in the bath method, namely, the modification founded on the before mentioned experiment made in 1879. This method may be thus described : Paper is coated with ferric oxalate and a small quantity of a mercury salt, then exposed to light, and afterward developed on a cold solution containing potassic oxalate and potassic chloro-platinite. The solution of ferric oxalate employed is the same as that used in the present process, both as to its strength and acidity. In each ounce of this ferric oxalate is dissolved from 1 to 1½ grains of a salt of mercury, preferably the chloride. Paper is then coated with this solution in such quantity that each square foot of surface will contain about 18 grains of ferric oxalate and one-tenth of a grain of mercuric chloride. It is then very perfectly dried, exposed to light under a negative, and then developed on a cold solution containing from 30 to 120 grains of oxalate of potash and from 5 to 15 grains potassic chloro-platinite. The development proceeds sufficiently slowly to allow of its being watched and stopped by immersion of the print in the acid clearing bath as soon as the desired strength of the deposit has been attained. It is certainly very strange that so small a quantity of mercuric salt should suffice. The quantity of this salt employed it is very important to limit to the proportion I have named, for if the amount be much increased, all artistic value is destroyed by the blocking up of the shadows, which become opaque and dead.

Now, as to printing and development. The printing is done in a printing frame in the usual manner. The image is at least as visible as in the present process, though it is not generally necessary to print so deeply or so strongly. That the requisite exposure is most certainly less than would be the case ordinarily with the ordinary paper is undoubtedly true, but it is impossible at present to form a correct estimate of the gain in this respect.

After the paper has been exposed, it may be kept several days before development without any visible deterioration.

In developing these prints, many variations may be made, both in the constitution of the developer and in the method of applying it. Various proportions and amounts of oxalate and of platinum salt may be used. I have, however, found it advisable to use not less than six grains of the platinum salt to each ounce of the developer. A good average strength is nine grains per ounce. The strength of the oxalate of potash solution may be varied between 30 and 120 grains per ounce.

With a strong solution of the oxalate very cold tones are obtained ; with weaker solutions, warmer tones. A good average is 50 grains of the oxalate to each ounce of water. This bath may be used either acid, neutral, or alkaline, but my experience is not sufficient to enable me to state which is the best state, but when the bath contains only a small quantity of oxalate of potash, it seems to be very advantageous to use a strongly acid solution. The constituents of this developer, when mixed in solution, undergo a slow mutual decomposition, hence it is necessary to mix them not too long before use. But this decomposition does not appear to affect the action of the developer until after the lapse of many hours.

In order to prepare the developer in an easy manner, a good plan is to keep stock solutions of the oxalate of potash and of the platinum salt. A good strength for the former is one pound of the salt dissolved in 54 ounces of water, and for the platinum salt 56 grains dissolved in one ounce of water.

Of the many methods of applying this developer, perhaps the most generally useful is by floating. The print is floated in the manner usual with platinotype prints, and the print may be allowed to remain floating on the surface until complete development has been effected. But I prefer to remove the print as soon as it has been well wetted, and then to hold it in my hand, carefully watching the progress of development until the right point has been reached, when I immediately plunge it into the acid clearing bath. Instead of holding it in the hand it may be laid on a piece of glass, or other convenient support, and then, by means of a brush wetted with the acid clearing solution, the latter may be applied to any parts which it may be advisable to prevent from reaching their maximum intensity.

For very large prints, perhaps the best and most economical arrangement is to apply the developer by means of flannel-coated rollers. The developer may also be applied very well by means of a spray producer, or it may be brushed on by a camel-hair brush. This brushing method might be valuable to an artist. The clearing, washing, and drying operations do not differ in any respect from those ordinarily employed. Prints made by this method are usually characterized by a much greater transparency in the shadows, indeed, as prints on matt paper, I might be permitted to say, a

* Paper was coated with ferric oxalate and mercuric chloride, exposed to light, and then developed on a boiling solution containing oxalate of potash and potassic chloro-platinite. Results: Vigorous and deep black in the shadows, but muddy in the high lights.

* Read before conference of Camera Club, reported in Dr. Jour. of Photo.

marvelous transparency. Now, this is perhaps one of the most important, and certainly the most difficult, effect to obtain on matt surfaces. I attribute this transparency to the method in which the pigment, platinum black, is applied to the paper. In this process the ferrous image on the paper reduces the platinum from the platinum salt in solution in the bath, and thus the pigment is, as it were, brushed on, not developed *in situ*. Another characteristic of these prints is the great purity of the whites obtained on paper which has been long or badly kept. This arises from the fact that the paper is coated with iron only, and does not contain any platinum salt.

In America, where large numbers of direct enlargements are made in platinum, difficulty is sometimes experienced, especially in hot and damp weather, by a staining of the whites. I have just received some examples of enlargements made by this new method in which a wonderful purity is obtained. This method offers very great opportunities for modifying the character of the results. Prints showing wonderful delicacy and softness, or, on the other hand, great boldness and vigor, may be readily obtained by slight alterations in the sensitizing operations, and these variations may be still further effected by changes made in development.

I will conclude by a statement of the principal advantages secured by this method. They are:

1. Greater transparency in the shadows.
2. Cold development.
3. Tentative development.
4. Shorter exposure.
5. Easy variation in the character of the finish.

MACHINE FOR MANUFACTURING BETON AND MORTARS.

THE manufacture of the cements called Coignet betons, after the name of their inventor, consists in making a mixture of sand, lime, and cement, slightly moistened, and in triturating this mixture in special apparatus, and then pouring the paste thus obtained in moulds, into which it is compactly rammed by manual power, or compressed mechanically.

Aside from the judicious selection of the crude materials and of the proportioning of the same according to the results to be obtained, the quality of these agglomerated betons depends chiefly upon the kneading, the object of which is to cover each grain of sand with a pellicle of the agglomerating material and make it adhere strongly thereto, so that, after the ramming and compressing that bring the grains close together, the cement and lime, on setting, shall secure a solid union of the whole.

It is very important that the materials shall be mixed before being thrown into the kneading machine, since, if the latter kneaded the sand or lime separately, the mixture, and consequently the masonry, would not be homogeneous; and, moreover, the machine would not produce its whole useful effect.

Mr. Edward Coignet, desiring to substitute machinery for hand labor in the operation of mixing, has devised and constructed for this purpose an apparatus that permits of quickly effecting the kneading of sand by fractions of 200 liters with the corresponding quantities of lime and cement, with the certainty that the kneaded mixture, and consequently the masonry, will

not only be perfectly homogeneous, but be increased in resistance, since the kneading is completer and is better done.

This mode of preparation is equally applicable to mortar and cement.

This inconvenience is avoided in the new apparatus, where the kneading proceeds from the bottom upward, so that the paste or mortar can be employed at the beginning of the operation. In this way, not only better results are obtained as regards the kneading of agglom.

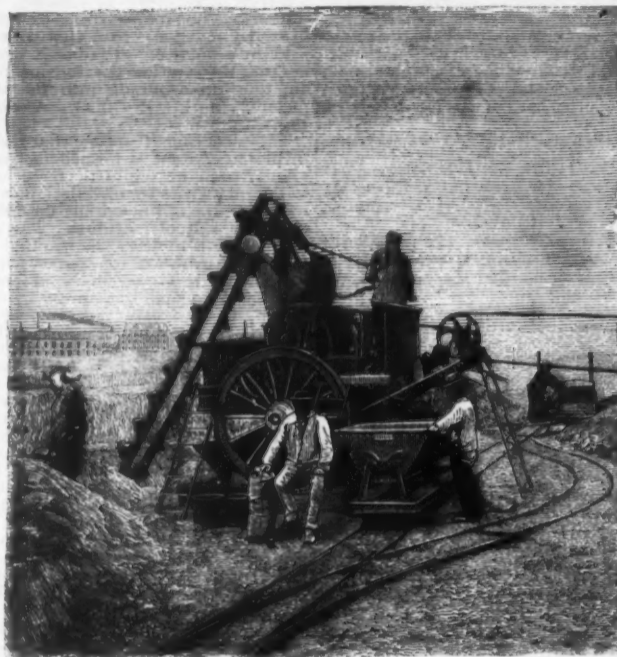


FIG. 4.—MACHINE FOR MANUFACTURING BETON AND MORTAR.

In ordinary work, the common vertical machines in use must always be kept full; nevertheless, at the beginning of each operation, although the vertical cylinder be full, the material that it contains makes its exit

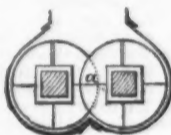


FIG. 3.—TRANSVERSE SECTION OF THE KNEADING APPARATUS.

without having been kneaded, and the use of it would give so bad results that it is necessary to pass it through the apparatus again.

erated betons and mortars, but also a great saving in manual labor.

This new apparatus consists essentially of an iron frame, G, with detachable shafts, and mounted upon wheels. It is provided with a platform, P, with a hand railing; with a water reservoir, R, with pipe and cock, r; and with a mixing machine, C, cast in a piece with a gauge box, B, and resting, through the cheeks, m m', upon the frame, G. To the lower part of the box, B, is attached a sort of ladder in two parts, supporting a bucket frame, A. A percussion frame, D, is suspended under the mixing machine by means of jointed rods. Finally, under the frame, there is a kneading machine, F, carried by the sole bars, through the shaft, M.

A portable engine actuates the pulley, N, of the shaft, Q, which drives the kneading machine, F, through the bevel wheels, n n', and the mixing machine, B, through the chain wheels, p p'. The shaft of the mixing machine in turn actuates the percussion frame through the wheels, j and j', and the bucket chain

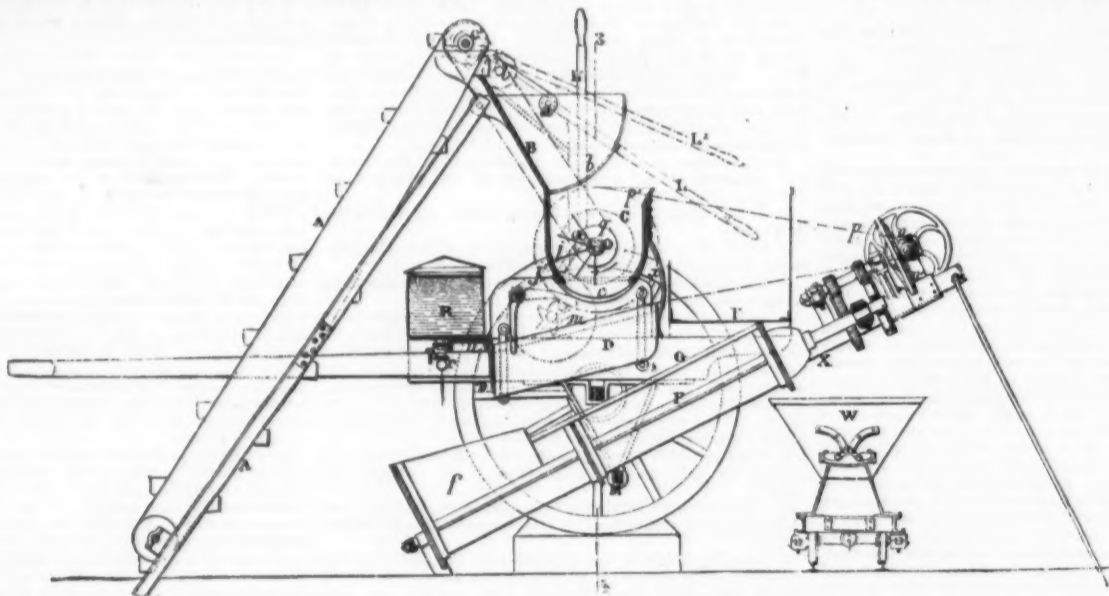


FIG. 1.—LONGITUDINAL SECTION AND ELEVATION.

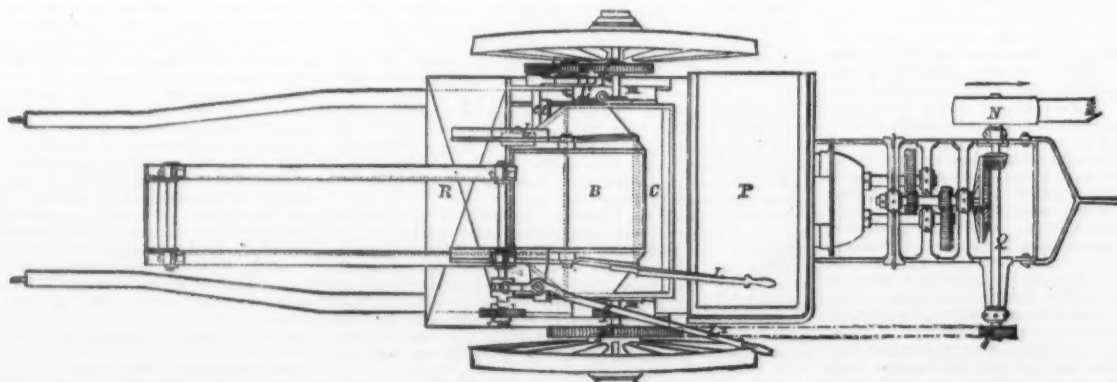


FIG. 2.—PLAN.

through the wheels, *g* and *g'*. Finally, upon the shaft of the bucket frame there is a coupling box actuated by a lever, *L*.

The apparatus operates as follows. The buckets rise and empty the sand into the gauge box, *B*. This latter has two of its sides inclined at such an angle as to secure a natural flow of the sand. One of its sides, *b*, forms part of a horizontal cylinder turning out of center around the axis, *a*, by means of the counterpoised lever, *L*. This arrangement, when once the box is full, permits of emptying it of sand instantaneously, even though the latter be wet.

As soon as the sand is in the mixing machine, *C*, a man standing on the platform, *P*, throws in the proper quantity of lime and cement. Then the arms mounted upon the rotary shaft stir and mix the whole. When the mixing is finished, the door, *c*, is opened by means of the lever, *L'*, and the material falls upon the percussion frame, *D*. A rod carried by the axle, *e*, and moved by a click actuated by the ratchet, *r'*, shoves the cross piece, *t*, of the frame and causes the recession of the latter, which the springs, *x*, push forward upon the cross piece, *u*, and at the same time give it a shock so as to cause a portion of the mixture to flow. A sliding valve, *v*, regulates such flow in a thin stratum, while the perforated pipe, *r*, allows water to flow from the reservoir, *R*, into the kneading machine. As the

machines as it appears in operation on the Champ de Mars, where it is being used in the construction of a sewer of agglomerated beton. It requires but two men to maneuver the apparatus properly so called. One of these shovels the sand into the buckets and regulates the flow of water from the cock, *R*, and the other, standing upon the platform, *P*, levels off the material emptied into the gauge box, *B*, maneuvers the levers, *L*, *L'*, and *L''*, and pours in the cement, etc. Besides these two men, it requires two or three others to bring the sand in wheelbarrows, to fill the reservoir, *R*, to hand the bags of lime and cement up to the workman on the platform, *P*, and to see to the filling of the cars.

In order to move the apparatus, the angle irons that unite the two uprights of the bucket frame are removed, and the upper part remains suspended from the box, *B*. Then the chain, *p p'*, is removed and the kneading machine is left to itself, and this, being heavier at its upper part, becomes horizontal. It now only remains to attach the shafts.—*Revue Industrielle*.

THE LOOKOUT MOUNTAIN INCLINED RAILWAY.

At a recent meeting of the American Society of Mining Engineers an interesting paper was read by Mr. W.

Midway on the plan (Fig. 1, enlarged in Fig. 3) the outer rails are shown as diverging, and the central rail opens out, or doubles, for a distance of 200 ft., forming two independent tracks or switches. This plan of a three-rail road, from end to end, was adopted for many reasons, prominent among which are:

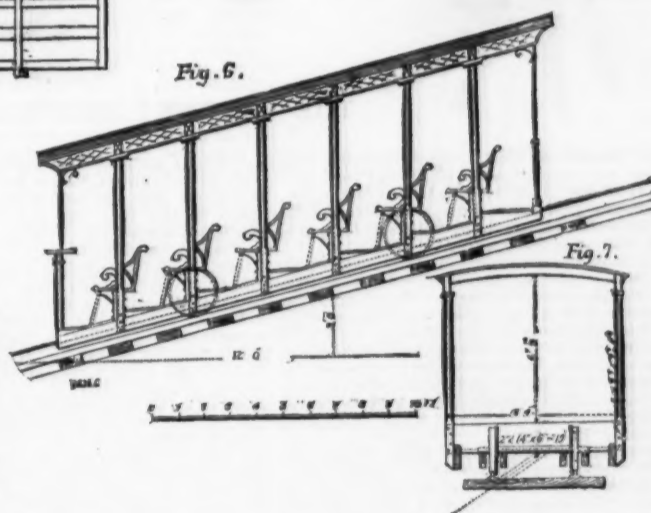
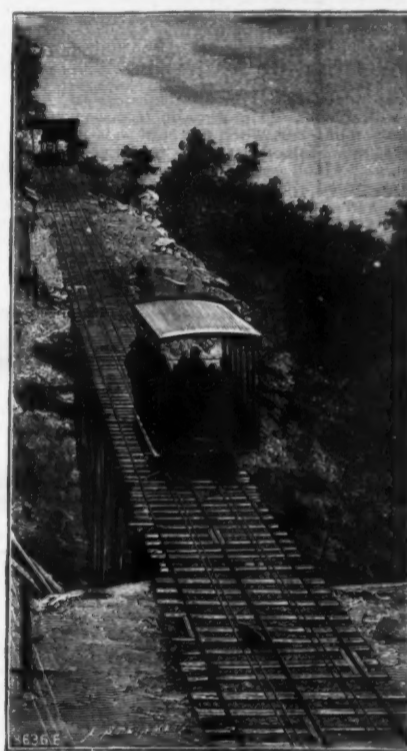
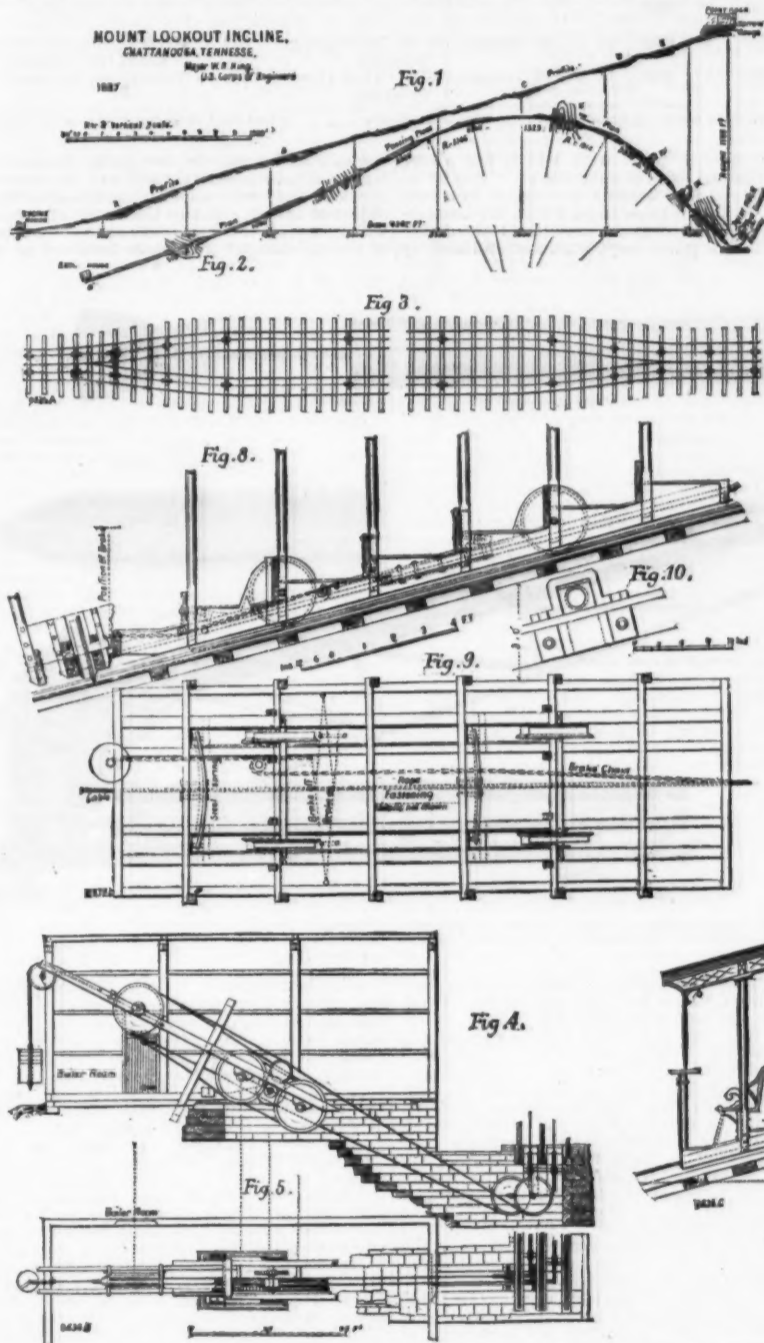
1. No movable parts are used at any point in the track; therefore there is no risk of accidents from the failure of parts to work under the varying condition of such service.

2. Solidity is assured by the extra width of the road-bed; therefore steadiness of running at high speed is practicable.

3. Sufficient space and play are given for the rapidly moving cables to hold the center of the separated tracks at all times, the grooved guide wheels, carefully spaced, holding the cars to the curves as evenly and truly as on the straight track.

The rails are of steel, 25 lb. to the yard, and laid on cedar ties 9 ft. long. No spikes are used, the rails being secured by heavy lag screws 5 in. long, the heads of which are re-enforced by wrought iron washers 2 in. by 3 in., which grip the base of the rail.

The cable consists of two sections. The upper one, 4,360 ft. long, and depended upon for the real work, is passed over an 8 ft. sheave at the summit, and to its ends are attached the two cars; and as the power is applied



INCLINED RAILWAY AT LOOKOUT MOUNTAIN, TENNESSEE.

shocks occur in rapid succession, the descent of the mixed materials to the lower part of the kneading machine really proceeds continuously. The kneading machine consists of two helices running round two shafts revolving in the same direction and placed in a cast iron box having the form of an ω . The helices knead the material between themselves and the box, but this effect is especially produced between the two segments, *a*, one of which rises and the other descends (Fig. 3). At the same time, the helices raise the mixture to the orifices, *X*, which are arranged at such a height that they can empty the prepared paste directly into the car, *W*.

While the kneading machine, *F*, is operating upon the material furnished by the frame, *D*, the mixing machine, *C*, is preparing a new charge, and the gauge box, *B*, is again filling.

As the apparatus is mounted upon two wheels, it has all the mobility necessary for the execution of a work of wide extent.

In Fig. 4 we give a perspective view of one of these

H. Adams, of New York, on a cable railway, constructed by Major W. R. King, of the United States Engineer Corps, from the base to the summit of Lookout Mountain, near Chattanooga, Tennessee, whence a wonderful panorama unfolds itself, but which before this line was opened for traffic was difficult of access. The following description and illustration of this work, taken from Mr. King's paper, will be found of interest.

By reference to Figs. 1 and 2* above, which show the railway in plan and profile, it will be seen that the line is straight for 1,250 ft., commencing at the base, curves to the left for 250 ft., thence runs in a tangent about 800 ft. (which distance covers the passing points for the cars), then curves to the right for 1,400 ft. and finishes with a stretch of straight line for 600 ft. to the base of bare rock which marks the crest of the mountain 1,500 ft. above the river level. The length of the track is 4,360 ft., and the elevation attained is 1,170 ft., or say 1 ft. of rise to 3 3/4 ft. of length.

* The pulleys shown in Fig. 2 should be between, not on, the ties; they are in reality much larger than they appear in this figure.

to the lower end of the system, the ends are spliced below the cars to the two ends of a second section of cable, thus forming a continuous driving rope. The center of the lower section passes over the grooved driving and tightening pulleys, arranged as shown in Fig. 4.

A large surplus of strength is allowed for in the upper or working cable, the maximum load being 5 tons, while the breaking strain is 50 tons. This cable is 1 1/4 in. in diameter, and composed of six strands of nineteen wires each. The driving cable is 1 in. in diameter, with the same number of wires. The sheave at the summit is held in place by a wooden frame anchored to masonry piers which rest upon and are bolted to the original rock.

Fig. 4 shows a section and elevation of the engine house and plant. The engines have two cylinders, 12 in. by 18 in., connected to the main shaft; a 20 in. steel pinion and two 80 in. gear wheels actuate the two 80 in. double and triple grooved driving sheaves.

The lead of the cable passes around the driving

sheaves, as shown in Fig. 4, and around a pair of smaller sheaves fixed in a sliding frame, to which is attached a counterpoise, serving to keep the cable uniformly taut, and allowing for changes of temperature or strains of any violent nature.

The engines are controlled absolutely by a system of levers extending into the tower of the engine house, the engineer having an unobstructed view of the cars at nearly all points on the line.

The boilers carry 75 lb. working pressure, and consume from 1,000 lb. to 2,000 lb. of bituminous coal per day (the cars making from 18 to 24 trips), or about 90 lb. of coal per round trip.

The importance of telegraphic relations between the cars and engine room was duly considered, and a very simple plan was devised by which either conductor can signal directly to the engineer from any part of the line, whether the car is moving or standing still.

The arrangement may be readily described without drawings, as follows: A small 8 cell Leclanche battery and an electric gong are located in the engine room. One pole of the battery is connected with a bearing of the main sheaves and thus with the cable, which forms the ground circuit. The other pole is connected through the magnets of the gong to an ordinary telegraph wire stretched between the rails and supported by insulators that do not rise above it, the wire being about 6 in. above the ties. To complete the circuit all that is necessary is to connect this wire with the cable, and this can be done at any point of the line by pressing a spring upon the wire, the other end of the spring being connected with the cable where it is attached to the car.

To guard against mistakes or possible failures to make the proper signal when in motion, it is understood that any signal whatever, when the engine is in motion, means "stop!" but a "start" requires a certain definite signal, which can of course be easily and deliberately made, as the car must be standing still when such a signal is required. This last signal is such that it could hardly be counterfeited by accidental contact of the wires or by malicious per-

and performances of this very remarkable weapon. The early portion of the paper, although exceedingly interesting and full of valuable information, was principally devoted to an historical sketch of the first efforts made by the inventors, so we will pass on to a description of the pneumatic tube, with which the most important experiments alluded to by Captain Haig were carried out, and of which an engraving, Fig. 1, is appended, as well as of its projectile, Fig. 2. Let us, in the first place, summarize these experiments.

Perhaps the most concise method of showing the results is to formulate the whole in a tabular statement, thus:

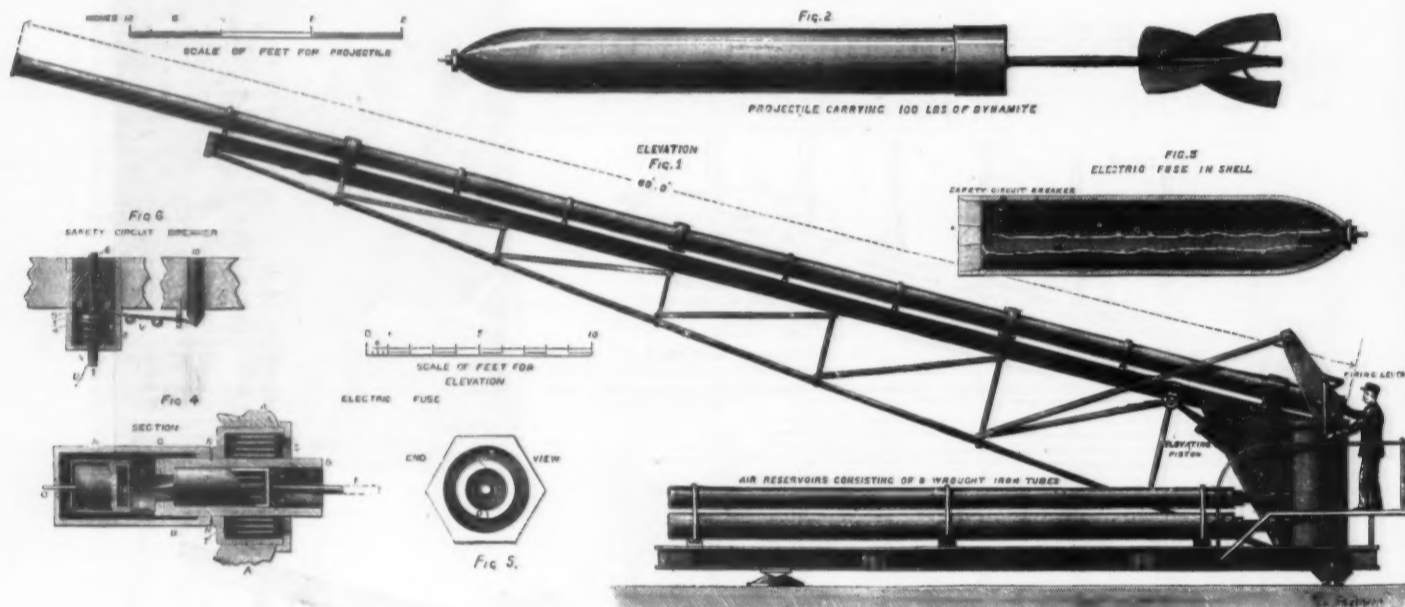
Date.	Gun.	Range.	Elevation.	Time of Flight	Bursting Charge in Projectile.	Air Pressure.	Results.
June, 1886, 5 r'ds	8	1613	10° 40'	Not known.	None.	1000	Four shells obtained exact range—one 7 yards over.
August, 1887.....	8	1900	...	9½ seconds.	None.	1009	Struck at 1,976 yards, owing to mistake of 9 lb. in air pressure.
August, 1887.....	8	2600	....	11 seconds.	Not known.	1000	Struck at 2,552 yards, and exploded.
August, 1887.....	8*	....	....	....	....	....	....
September, 1887.	8†	2300	....	....	....	....	....
September, 1887.	8	2200	14° 0'	13 seconds.	55 lb. blasting gelatine.	600	Struck at exact range and disabled the Silliman.
September, 1887.	8	2200	14° 0'	13 seconds.	55 lb. blasting gelatine.	600	Destroyed the wreck altogether.

* Was a blank one to test a new iron tail, which broke in mid-air.

† Two blank shells first fired to get the range.

The 8 in. pneumatic tube, with which the above practice was obtained, is thus described: "It is 60 ft. long, and consists of four lengths of wrought iron tubing lined with a drawn brass tube, which are respectively ¾ in. and ½ in. in thickness, making a total of only ¾ in. of metal. The gun is supported and stiffened by

one mile and a quarter, two shells, charged with blasting gelatine, successively fell into the precise position at which they were aimed, shattering to fragments the object of attack. Hence the storm of opposition with which the lecturer's opinions as to the probable future of the pneumatic gun were received at the United



THE ZALINSKY PNEUMATIC DYNAMITE GUN.

sons. It should be noticed that, even if the cable were to be broken at any point, there will always be a connection one way or the other back to the engine house; and if a car should jump the track, the spring would come in contact with the insulated wire and thus give an instant signal to stop the engine.

Figs. 6 and 7 show the construction of the cars, which were built as low as possible, and are provided with a special form of brake shown in Fig. 8. This brake acts in an entirely different manner from the common style of car brake, the conductor being obliged to hold it off during the entire trip, or whenever the car is in motion. If, by accident or design, the hand wheel is released, the brake is instantly forced under and against the front of each wheel, so as to lift the wheels entirely off the track, thus converting the car into a sled, of which the brakes are the runners.

The bottoms of the brakes have soles of wrought iron with short steel pins (twenty-four in number) projecting slightly from the surface and sharpened like an engraver's tool. It is proposed to try a shoe with a V-shaped groove to take the head of the rail, the amount of friction being increased by the sharpness of the angle into which the head of the rail will be wedged by the weight of the car and load.

An automatic attachment causes the brake to set in the same manner in case the cable should part, even if the conductor should continue to hold on to the wheel; and still another and independent automatic grip is contemplated, to be actuated by a governor attached to the car axle. It should be added that the springs which actuate the brakes are not required to be bent more than six to eight minutes at a time, and will not be likely to take a "set," as is the case with springs on some forms of hoisting machinery which are kept under strain for months at a time. Fig. 9 is a view on the upper portion of the incline, showing a car crossing one of the trestles. The oblique wheels carrying the cable are also seen.

THE PNEUMATIC DYNAMITE GUN.

THE lecture which was recently delivered by Captain H. De H. Haig, of the Royal Engineers, at the United Service Institution, upon "The Zalinsky Pneumatic Gun," and the discussion which ensued thereon, have thrown an immense amount of light upon the power

and performances of this very remarkable weapon. The early portion of the paper, although exceedingly interesting and full of valuable information, was principally devoted to an historical sketch of the first efforts made by the inventors, so we will pass on to a description of the pneumatic tube, with which the most important experiments alluded to by Captain Haig were carried out, and of which an engraving, Fig. 1, is appended, as well as of its projectile, Fig. 2. Let us, in the first place, summarize these experiments. Perhaps the most concise method of showing the results is to formulate the whole in a tabular statement, thus:

The 8 in. gun throws a shell containing 100 lb. of explosive to a distance of 3,000 yards with an elevation of 33 deg. and a pressure of 1,000 lb. The projectile is made of drawn brass or mild steel, with a solid head, to get the center of gravity well forward. As the pressure in the bore is so small, it was a desideratum to get the shell as light as possible, and so the walls are made very thin. This could be done with safety, for, unlike an ordinary gun, there is no rifling to necessitate strength and stiffness, and the friction in the bore being very small, there is little to strain the walls of the shell. It was necessary for accuracy, however, that the projectile should revolve about its longer axis, and to make it do so a tail with spiral wings at the end is attached. The most satisfactory results have been obtained from metal tails about 2 ft. long, with metal

Service Institution is a little difficult to understand. One speaker drew unfavorable comparison between it and armor-piercing weapons, stating that the latter would "come into action first," and so on. Another compared it with the Whitehead torpedo, while a third actually introduced the Maxim gun into his field of argument. Now, as a matter of fact, the pneumatic gun bears no comparison with either of these engines of warfare, for the simple reason that it is not designed to compete with them. Its functions are those of "high angle firing" exclusively. Hence the objections to its high trajectory are unreasonable. Moreover, these functions possess most valuable attributes at a time when neither our land forces nor our navy is provided with a single high angle firing gun of any power. Our siege guns and howitzers can only project a shell with a bursting charge so inconsiderable that it would scarcely injure a powerful ironclad. Colonel Brackenbury's objections seem to have been a little wide of the mark, as he condemned *in toto* the whole range of high explosives, owing to their dangerous characteristics in manufacture and in use. At the same time, he considered it advisable to conduct experiments with the Zalinsky gun in England. But as it is difficult to form a consecutive and useful opinion from a mere recapitulation of the arguments of the various speakers quoted *seriatim*, we will give briefly the *pros* and *cons* arranged in order for reference, omitting the names of the speakers.

Favorable Remarks.—The pneumatic principle is valuable as giving great accuracy and uniformity of range. The smokeless nature of the discharge and its noiselessness are most important characteristics. For coast defense, the naval officers present considered that the pneumatic gun might form a powerful adjunct, but its principal usefulness would be confined entirely to the military service.

Unfavorable Remarks.—The great length of the Zalinsky gun is a most objectionable feature. If reduced so materially as promised by the inventor, it would be impossible to create a sufficient pressure of air to give anything like a considerable range. Gun pits constructed for this weapon would be mere "shell traps." The tails of the projectiles are an insuperable objection, owing to their erratic propensities. This method for effecting rotation should be abolished and rifling take its place, another motive power being applied in

reference to the pneumatic. The low velocity of projectile would render fire against moving objects inexact, and the interval that elapses between the moment of pressing the firing lever and that of the shell leaving the muzzle is a serious drawback to the usefulness of the weapon for following the movements of a passing vessel. The proposal for traversing guns by the action of steering, as arranged for the American government, is considered by naval officers to be impracticable.

With regard to the nature of the objections raised as quoted above, some are of importance, others might equally apply to any known weapon at present in use. All open gun impositions are mere "shell traps," and will prove to be so at the first trial to which they are subjected. The objection as to length appears somewhat frivolous. Let us at least reserve an opinion until Zolinsky has proved whether he can reduce it within reasonable limits. After all, 40 ft., which is to be the length of the heavy tubes for the new American cruiser, is less than that of an 11 ton gun, and the inventor proposes to reduce it still further. The criticism as to "method of rotation" is, we fear, not without justice. Some years ago attempts were made by a scientific expert to improve the flight of the Hale's rocket by a better system of tail adjustment. It was found impracticable, and rockets still remain now, as they were then, uncertain and erratic engines of warfare, better qualified to frighten a savage foe than to do any definite injury. The difficulty as to the low velocity of the projectile, although we admit it to be absolutely fatal to the success of the invention against moving shipping, will, we think, be eventually overcome by a person of such infinite resources as Lieutenant Zolinsky, the ingenuity displayed by him in his electric fuses—to be presently described—being sufficient to warrant such a surmise. But we think that this objection has, perhaps, been exaggerated. If a projectile containing 600 lb. of blasting gelatine falls within 100 ft. of the bottom of an ironclad, there is little doubt that the vessel would be disabled. Since the reading of Captain Haig's lecture valuable testimony has been adduced on this head. On the 4th of Feb., in Portsmouth harbor, a charge of only 91 lb. of gun cotton was exploded 30 ft. from the sides of the Resistance, which it sunk at once; 91 lb. pound of gun cotton would be about one-tenth of the strength, or even less, which would represent the blow delivered by 600 lb. of blasting gelatine. Hence we think that the area of destruction which would be involved by the explosion of a Zolinsky projectile with 600 lb. of blasting gelatine would be sufficient to allow for very considerable errors in deviation or in range. It is clear that the pneumatic firing tube has a future; even its bitterest opponents admitted that. The value of a weapon which can project a huge mass of powerful explosive equal to three quarters of its entire bulk of projectile to a distance of one and a half miles with perfect accuracy cannot be disputed. Whether it will ever be made usefully applicable for naval purposes is doubtful, though for countermine service, as we stated in our columns last week, it would be very effective. We consider that Admirals Boyes and Colomb probably gauged its capabilities correctly when they pronounced it to be valuable for military service and coast defense only; indeed, there are hundreds of salient points around the coasts of Great Britain and Ireland where the presence of a battery of these pneumatic guns would be no small safeguard to the security of the enormous commercial interests involved, at present wholly unprotected. Whether the cruiser now in course of construction for the American navy will be a success or otherwise, it is impossible to determine. It is a problem which remains to be solved. Hitherto the United States have not been conspicuously happy in their choice of war materiel. "The new cruiser, which is now being built by Messrs. Cramp & Sons, of New York, is to carry three pneumatic guns, two of 10½ in. and one of 12½ in. The 10½ in. shell will contain 200 lb. of explosive gelatine, equal to 330 lb. of dry gun cotton, and the 12½ in. 400 lb., or equal to 650 lb. of the same explosive. The guns will fire fore and aft, and will be directed by steering the vessel, the contract speed for which is 20 knots an hour." As before remarked, the specified length is 40 ft.; but the inventor says he can reduce this to 24 ft.

Whatever may be the opinions of artillerymen and experts as to the gun, there is but one verdict as to the nature of the fuse employed. It is a marvel of ingenuity. "Two electric circuits are placed in the shell, the motive power being small chloride of silver batteries. Either of these circuits, when closed and complete, will cause a current to pass through a detonating fuse in the base of the shell. (This remark is in italics for a reason which will be obvious presently.) The current burns a short piece of platinum wire, which ignites the detonating composition, and it in turn explodes the charge. These two circuits are kept open and incomplete until the right moment, thus: the first one has a gap in its circuit in the front of the shell which cannot be closed before a plunger moves forward, and this can only happen on the motion of the shell being suddenly arrested by some hard substance; the second circuit is complete, but the battery is dry, and there is consequently no current. If, therefore, the shell falls into the sea, an arrangement is made by which sea water penetrates through a hole in the shell, wets the cotton wool in the cells of the battery, starting the current, which fires the shell as described." There is thus no possibility of a "premature." This fuse is said to act with great precision, and both in contact with a hard substance and when falling into water a little practice is sufficient to insure uniformity or variety of action as required. The ignition of the bursting charge in the projectile, from the base, was found to produce the best possible results, having a far more destructive effect upon a target than when the detonator was placed in the point of the shell. This fact was commented on with considerable interest by artillery officers at the Institution. There is no doubt that the effect of a base detonator is to throw the charge forward and intensify its shattering powers. The details of the electric fuse will be best seen by a reference to the accompanying sketches, which illustrate its features; as also those of the "safety circuit breaker," which has been patented by Lieutenant Zolinsky as well as the fuse.

In Fig. 4 indicates the body of the projectile, of any known form, and having a charge chamber, A, Fig. 3; B designates the electric fuse, which is shown in Fig. 3, in the point of the shell, but may be in the base or any other part. The electric battery in the

fuse is connected by an electric circuit with a detonating charge, C, preferably at the base of the shell. The fuse, B, contains an electric battery, D, Fig. 4, of small size. This battery is put up with the chemical sensitizing agent in a dry state, and is made active by moisture. The battery, D, has a penetrating point, E, and is inclosed in a strong steel tube, F, which tube, F, is held in fuse case, G, by pins, H. The battery, D, has a projecting stem, I, a little longer than the tube, F. A plunger, L, preferably of lead, is placed in the fuse case below the battery, D, and a rubber diaphragm, M, is interposed. The fuse case is lined with rubber or a similar non-conductor for a part of its length, and the plunger, L, lies between the wires, O, which are united and lead to the detonator, C. A non-conducting ring, Q, is interposed between the plunger, L, and the battery, D. Battery, D, has sharp prongs or fins, R R, which prevent it moving toward the outer end of tube, F, when it is once driven in. The battery, D, is made sensitive by wetting the contents before it is placed in the fuse. Outside the tube, F, there is a second battery, S, which is intended to be kept dry until the projectile is fired, and has fallen into water, admitting the latter through the aperture in the fuse. This battery, S, also connects with the detonator, C, by the wire, T. The detonator, C, may be the common electric primer for guns, having a fulminate charge surrounding a platinum bridge. Supposing the fuse to be in the point of the shell, A, and the battery, S, in position shown in Fig. 3, but the battery, D, just entered in the front of tube, F, as shown in dotted lines. When the shell is fired from a gun, the shock of discharge will drive the battery, D, into the position shown in full lines. It will also set back the plunger, L, as far as possible between the wires, O. Now the point, E, of the battery does not quite touch the rubber diaphragm, M, but if the progress of the projectile be retarded, as by striking the sea, the plunger, L, will be thrown forward until the point, E, passing through the rubber diaphragm, M, strikes the plunger, L. As this plunger is in contact with the wire, O, which connects the detonator, and the circuit is complete through the wires, U and V, to the body of the shell, A, which is also in metallic circuit with battery, D, this closing of circuit will fire the detonator. The little time taken by the plunger, L, in moving forward gives a short interval for the projectile to enter the water, and this interval of time may be made longer by increasing the length of the fuse case, G, so that the plunger will have further to move. Should the point of the projectile strike a solid target, as an armored vessel, the tube, F, will be driven in, carrying battery, D, with it, and the electric circuit will be closed and the shell exploded before the real point of the projectile strikes the target. It is very important in firing dynamite shell that the explosion should take place from the rear of the charge, and if it be against a solid target that the detonation shall take place by means of the detonator, and not from simple concussion, as the concussion produces a much less powerful explosion than that caused by a powerful detonator.

Should the battery, D, by any mischance fail to explode the projectile, if it falls into the water a quantity of water will reach the dry battery, S, and when this battery becomes active it will close circuit through wire, T, and the other connections to the detonator. To avoid accidents, such as the bursting of a charge of dynamite in the gun, a circuit-breaking apparatus is produced as follows: The wires, O and T, are insulated, and a further part of their circuit is the insulated wire, U, Fig. 6. This wire, U, connects with a plunger, 1, which is in a casing, 2, but insulated therefrom. The plunger, 1, has a head, 3, which is pressed forward by spring, 4. A metallic ring or plate, 5, in the casing, 2, has the wire, V, connected to it. The casing, 2, is screwed into the outer wall of the shell, and an insulated pin, 6, enters said casing from the outside. When the projectile is entered into the bore of the gun, the walls of the gun will press in this pin, 6, thus breaking the electric circuit between the head, 3, and plate, 5. As soon as the projectile gets out from the muzzle of the gun the spring, 4, will push out pin, 6, and bring plates, 3 and 5, in contact, thus closing electric circuit from wire, U, to wire, V. Wire, V, which is insulated, leads to the vicinity of pin, 10, but is kept from contact or from metallic connection with the walls of the shell until said pin, 10, is inserted or screwed into place, when the circuit is closed to the casing or wall of the shell, and as the metallic connection from the shell body is complete, it follows that when pin 6 is forced out and pin 10 pressed in, the electric circuit from the battery, D, through the detonator is only broken between the battery and plunger, and this is closed quickly when the projectile strikes a solid target, or slowly when it strikes a somewhat yielding target, as has been explained.

When the projectile is being handled the pin, 10, is left out. As soon as the projectile is ready to load into the gun, the battery, D, having been inserted, the pin, 10, may be put in place; but if pin, 6, be pressed in, either by hand or by the wall of the gun, the electric circuit will still be broken. Should the battery or plunger be displaced by the shock of firing, or should it absorb moisture and become sensitive while in the gun, the circuit could not be closed to fire the charge until the projectile leaves the muzzle of the gun, so that pin, 6, can be pressed out by the spring, 4.

An unfortunate obstacle exists to the chances of the Zolinsky gun being experimented upon in England. The inventor now absolutely refuses to sell for such purposes a single weapon. As this decision would involve the expenditure of a large sum of money, in the event of the war department considering it advisable to institute a series of trials with a whole battery of such weapons, we think it improbable that the outlay will be sanctioned by Parliament. Most likely, therefore, we shall have to await the result of further experiments made in America before anything is done by the British government. Spain and Italy have each ordered a pneumatic gun some time ago, and before Zolinsky had come to the above decision.—*The Engineer*.

A LUMINOUS HEAT BELOW THE RED.

It is generally accepted that the first self-luminous appearance of bodies internally heated is that of dull red; the temperature corresponding to which is generally understood to be 525° C. or 977° Fahr., although a slightly lower number of degrees is sometimes assigned to the beginning of this phenomenon: Box stating that red becomes visible at 960° Fahr. Herr H. F. Weber now observes that red may not, after all, be the first

visible indication of heat; and he declares that the carbon filaments of incandescent electric lamps, as well as wires of platinum, gold, and iron, give out what he describes as a "gray glow," which becomes visible at temperatures much below that of the dull red. Gold produces this gray effect at 417° C., iron at 377° C., and platinum at 390° C. It does not appear, however, under what conditions this gray appearance of heat is observable, or how it is to be reconciled with what is commonly accepted as the gradation of colors in the spectrum.

E. RAUB'S NEW THERMO-ELECTRIC BATTERY.

By G. BETZ.

FOR years it has been the endeavor of electro-technicians in constructing electric generators to devise appliances which should not merely surpass earlier models in simplicity, but should also be capable of converting any given power into electric energy in the cheapest manner, and which should, in short, perfectly meet all the demands made both by specialists and by the outside public. It is certain that in the future the direct transformation of heat into electricity will afford the possibility of generating electric energy in the simplest, cheapest, and most practical manner. Hence it is desirable and advantageous that as much attention should be given to the improvement of thermo-electric batteries as there has recently been bestowed upon dynamos.

An essential advance in this sphere has recently been effected by a new construction of a thermo battery devised by E. Raub, of Berlin. It is of prominent importance, since in it all the shortcomings of the old thermo batteries have been removed, and since it is applicable at a small working cost for many technical



purposes, especially for electrolytic uses, and since the first outlay is very low.

As will be seen from the accompanying figure, the battery consists of two main portions: 1, the annular elements and the heating channel which they form; and 2, the refrigerator, which is applied separately. The circle shown in the figure behind the tripod represents a single element; the positive electrode is formed by a ring of an alloy cast around a copper heating ring, thus effecting a very durable and intimate metallic connection. Externally it is inclosed in a second ring of copper, with refrigerating projections arranged radially. The negative metal is soldered to the heating ring in thin plates, and in such a manner that during working, local currents at the points of contact are entirely avoided. After the elements have been built up, the negative metal of each is soldered to the refrigerating projections of the following element.

A number of similar thermo elements, of any desired size, are insulated from each other by means of a fire-proof material, and pressed together between two cast iron plates in such a manner that the several rings are superimposed concentrically, forming in this manner a firm, safe hollow cylinder which serves as the heating chamber. The heating is effected by means of any convenient source. For smaller apparatus like that shown in the figure a ring-shaped Bunsen gas burner is sufficient. For larger batteries a coal or coke fire is required. The flame of the Bunsen burner, screwed on to the lower end of the heating cylinder, comes in intimate contact with the heating rings of all the elements, and takes up its supply of oxygen within the conical flame. The heat is distributed equally to the elements by means of a slender cone fixed to the cover of the heating chamber and projecting into it. It then passes through a transverse channel into a wide stove pipe closed below and screwed into the supporting tripod and connected with a chimney having a good draught. The hot air ascending in the chimney draws fresh air into air pipes fixed below the point where the heating chamber vents into the main pipe, so that the external points of contact of the annular elements are kept cool by the draught. A valve is introduced for the regulation of the latter.

Great economy in working is effected by the application of annular thermo elements in combination with this forcible introduction of air, which admits of the

greatest possible utilization of the heat and the production of the greatest possible differences of temperature. Collateral advantages are rapidity and ease in starting work and a minimum requirement of space, since batteries to be heated by gas may be mounted upon a bracket. As valuable features must be mentioned the durability and firmness of the separate elements, as also the possibility of removing damaged rings either for repairs or for the substitution of new ones, which may be procured singly from the makers.

The three smallest models to be heated with gas and suitable for the electrolytic production of metals, for galvanoplasty, etc., consume hourly 300, 500, and 900 liters of gas (or about 11, 18, and 30 cubic feet), having strengths of current of 10, 30, and 40 amperes with an electromotive force of 3 volts. For an hourly consumption of 1 cubic meter these batteries give a useful effect of 80 volt-amperes, while those of former constructions yielded at most 27.—*Electrical Review*.

A NEW PATTERN OF REFLECTING GALVANOMETER WITH LAMP AND SCALE.*

By G. L. ADDENBROOKE.

THE instruments which I am about to describe are the outcome of improvements and modifications which have suggested themselves from time to time as the result of a good deal of experience in electrical testing for telephonic, electric lighting and general experimental purposes. As usually constructed, the reflecting galvanometer is essentially a laboratory instrument, demanding care and skill for its management, besides being costly. Perhaps the greatest objections to it are, however, the difficulty of moving it and setting it up, and the time usually taken to put it right when it gets out of order.

When, however, it is in good working order, there is so much satisfaction in working with it that one returns with reluctance to the use of other instruments. It is needless for me here to point out the various ways in which such galvanometers are now used, practically and experimentally, nor does it exactly come within

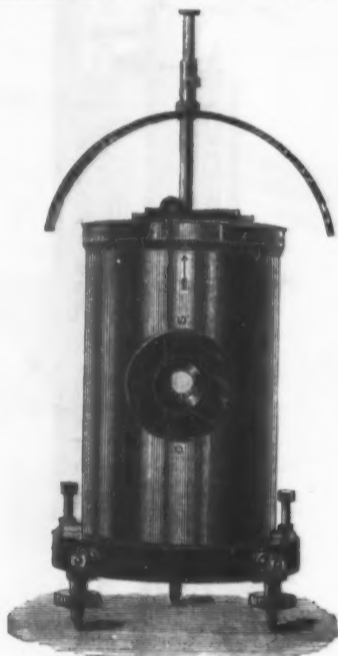


FIG. 1.

the scope of the paper to enumerate the uses to which this instrument can and probably will be put, in connection with the great extension of electrical engineering which is now taking place.

In the instrument before you it has been my aim, while preserving to the full the sensitiveness usually obtained in good laboratory instruments, to simplify and alter the construction, and thus fit it better for everyday needs, without at the same time diminishing its efficiency for the work with which it is now more particularly associated. It is constructed as follows:

Fig. 1 shows the instrument complete. The base is circular, and five inches in diameter. The case is of brass, its top being six inches above the base. The adjusting magnet, which is removed for carriage, rises eight inches further. The instrument is thus very small and compact. The adjusting magnet works up and down on its rod, a slot in the rod preventing lateral movement. Lateral movement is provided for by rotating the top of the case, which is marked with degrees, so that the magnet can always be brought back to the same position again directly, if it is necessary to move it.

The spirit level or levels for setting the instrument are on the top of the lid. The case itself is provided with two L pieces at the bottom engaging in two screws with milled heads on the base. By giving them half a turn, and rotating the case slightly, it can be lifted off.

Fig. 2 shows the appearance of the instrument when the case is taken off. Rising from the base are two parallel uprights of ebonite; four brass rods pass up through these, holding them in their places on the base and forming the means of connecting the terminals with the wire on the bobbins. Further, there are four small thumb screws which will be seen near the top of the ebonite uprights, two on each. These screws pass through the brass rods I have mentioned and into the outside cheeks of the bobbins.

The shape of the bobbins themselves will readily be seen in the figure. The outside cheeks are left much thicker than the inside, and all the cheeks project about $\frac{1}{4}$ inch beyond the coils of wire. The lower halves of these projecting cheeks are cut away at the

sides, as can be seen in the figure, leaving the upper portions projecting so that the coils rest on the projecting portions on the ebonite uprights and slide exactly into their places. The cut-away portions of the thick ends of the bobbins are faced with brass plates to which the ends of the coils are soldered. The thumb screws above mentioned screwing into the brass plates complete the connections and hold the bobbins firmly in their places. Both bobbins can thus be taken out in a moment without disturbing the needle, there are no awkward connections to make or to get out of order, and if desirable several sets of bobbins can be made,

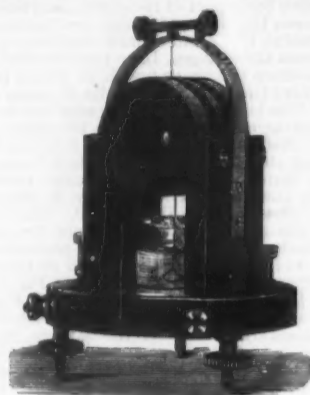


FIG. 2.

wound with different lengths and sizes of wire to fit the same instrument, which can be interchanged without trouble at any time.

Now we come to the needle. The suspension is of quite a different type from that usually employed. A brass hoop will be observed passing over the center of the bobbins and screwed at either end to the ebonite uprights. The whole galvanometer is put in the lathe and a very small hole bored centrally through this brass hoop. A V-shaped slot is then cut in the brass hoop from the front toward the back of the instrument, the point of the V groove ending in the small central hole. About $\frac{1}{2}$ inch on each side of the hole two brass uprights are fixed; they are forked at the top and hold a little ebonite rod with milled heads at each end. One end of a silk fiber is attached anywhere on this rod, the other end is attached to the needle. The fiber may be a yard long if desired. The ebonite rod is then turned, winding the fiber round it until it (the fiber) is about the right length, and then the ebonite rod is slipped into its place. The fiber then, if it is wound the right way round the rod, at once automatically centers itself, and by rotating the rod the needle can be set exactly. By this means a long suspension is secured, and if it is desired several rods and needles can be kept for different purposes. Say one with damper for general use, and a finely balanced astatic one for delicate testing, a ballistic needle for condenser work, etc. When the instrument has to be carried about a great deal, spare needles ready suspended can be kept and be put in, in a minute at any time, should an accident happen. If the suspension of a needle does break, it is often at a critical moment when time is important. To replace it as usually suspended is, as a rule, a long and tedious job; much valuable time may therefore be sometimes saved by the use of a suspension of this character. It will readily be seen that attaching a new fiber is a very simple and short operation as compared with that necessary with the ordinary type of instrument. The needle itself consists of a stiff aluminum wire carrying the magnets and mirror.

For all ordinary testing work I prefer to bend the lower end of the aluminum wire round into a loop and flatten it out. This makes an excellent damper; it is sufficient to prevent long swinging and annoying vibrations without rendering the instrument dead and sluggish. This damper works in a little glass jar fixed in the base of the instrument. The jar has its edges turned over to prevent the liquid being spilled when carried about. It is, of course, easy to add a second pair of coils on the same principles as the two in the

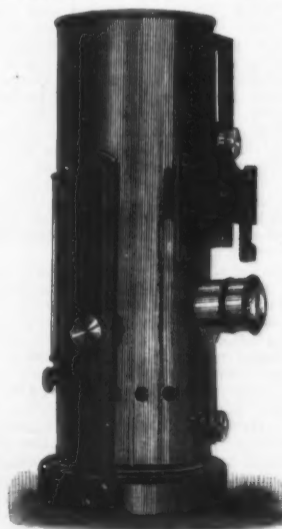


FIG. 3.

instrument before you, should it be desired, but a constant of 1 degree deflection with 1 volt through 1,000 megohms can easily be got with a single pair of coils, which is more than sufficient for most purposes.

In using reflecting galvanometers, a lamp and scale are required. All who have had experience in work-

ing with such instruments know that there is often as much trouble with the lamp and scale as with the galvanometer.

In the lamp and scale I have here I have tried, while securing the maximum efficiency, to reduce the whole within as small a compass as possible. The lamp itself consists of a copper tube about 12 inches long and $\frac{1}{4}$ inches in diameter. The bottom of the tube forms the reservoir, the top portion acting as a screen. This tube is supported by guides at the sides attached to a metal base, and which permits of the lamp being moved up and down through a total range of 6 inches.

In order to fill the lamp easily, a funnel is provided in the top of the reservoir with a tube attached which reaches nearly to the bottom of the reservoir. In this way the lamp can be quickly and cleanly filled, and there is no need of a screw stopper to keep the paraffin from spilling or evaporating.

Most essential points in the construction of a lamp are that the longer axis of the flame and the axis of the lens or slot should coincide, and further that the intensest part of the flame should be opposite the center of the lens. In this lamp, by prolonging the rod carrying the milled head for adjusting the wick, and causing it to fall in a slot in the tube just below the door at the back, the longer axis of the flame is always kept in the proper place. Again, the height of the burner is carefully adjusted to be right when the lens is in a horizontal position. Further, to allow the lamp to be used in various positions and with different instruments, the lens tube is made adjustable through a considerable angle, its axis of rotation being the center of the flame. In this way a beam of light can be thrown upward or downward, as well as in the horizontal direction. This is in working often a matter of great convenience.

For use with the lamp I have arranged a specially portable scale and shade. The scale itself consists of $\frac{1}{2}$ a meter, divided into millimeters. It is mounted on a thin board, as usual; this board is attached to a shade of the same length by long hinges. The whole is then cut through the middle, and a hinge fixed on the back of the shade. By this means the whole folds into half its length. Guides are fixed on the back of the scale, which engage in lock fixed to a cross piece on the front of the lamp, so that the scale slides easily backward or forward, and means are provided for raising or lowering the scale by itself, which is often convenient.

For carrying about or putting on one side, a box is arranged to take both galvanometer and lamp, with room for shunts and other accessories. The size of this case is rather less than is required for the ordinary pattern of lamp alone.

The maker of the instruments is Mr. J. J. Hicks, of 8, 9, and 10 Hatton Garden.

IMPERIAL QUICKSILVER MINES AT IDRIA, AUSTRIA.

It will soon be four hundred years since the discovery of mercury in Idria by a cooper who had set a pail under a dripping spring. He found metallic mercury on the bottom of the vessel, and told a *Landsknecht* named Cancian Anderle of his discovery. The latter, with the discoverer and others, formed a company for getting out the ore. In 1594 this company sold out to a corporation, which began operations energetically. In 1597 the Emperor Maximilian opened a mine in Idria on his own account, but in the same year the Venetians invaded the country and seized the mine. In 1510, however, they were driven away again by the imperial troops. The mines were then rented by Maximilian to the St. Achatz Mining Company. Between 1521 and 1531 the Castle Gewerkenegg was built by the company for the protection of their property, and here the directors of the works can still be found. In 1580 all of the mines came into the possession of the ruling prince, and the Mining Reservation for Montanwerk was founded by the "Carolina Mining Law for Idria," which still stands. Since that time the mines at Idria have belonged to the state.

The old mountain town is separated from the world by the steep hills which surround it; it has over 4,000 inhabitants, and contains 400 scattered houses. The Idria, which is as clear as crystal and rich in trout, runs through the city and supplies the works with the water power for turning the water wheels which operate the pumps and the hoisting machinery. Besides the castle already mentioned, other buildings were erected, among which are twenty-one dwellings for the officers and workmen, the church, the parsonage, the pretty schoolhouse and theater belonging to the works, the shaft buildings, the spalling house, the powder tower, and the dynamite magazine. The principal entrance to the mine (the "Antoni-Stollen") is in the center of the city, and there, in the large entrance room, the visitor is supplied with mine clothes, although the excellent condition of the mine renders them almost unnecessary. Generally one of the officers offers his own services as guide, but sometimes the visitor is left to the care of an experienced overseer.

The imperial quicksilver mines cover an area of about 111 acres and are provided with six shafts. There are now 959,430 cubic meters of ore in the mines, which, with a yearly output of 13,630 cubic meters, will last 70½ years. The quicksilver at Idria occurs partly as native silver in globules (this is collected in leather bags), but most of it is found in combination with other substances, one of which is *Brandert* (burning ore). This latter has received the name *idriant*; it is found at great depths and is very inflammable, and is, therefore, thought by many to be the cause of fires in the mines. In the deepest idriant shafts a temperature of about 90° F. prevails, although the best appliances for ventilation known are employed.

The ore which has been blasted or hewn out is delivered to the stamping mill, where it is prepared dry and is finally treated in shaft and reverberatory furnaces. The shaft furnace consists of a cylindrical shaft with small fire boxes built on, and it is covered on the outside with iron plates. In the reverberatory furnace the ore is spread on the floor of the furnace and is roasted by the flame which sweeps over it. The gases from the furnaces of both kinds pass through condensation tubes which are sprayed on the outside and into a common condensation chamber, from which they pass through an enormous chimney to the open air. On account of the great length of the cold tubes through which the quicksilver fumes have to pass, the metal

* Read before the Physical Society, March 10.

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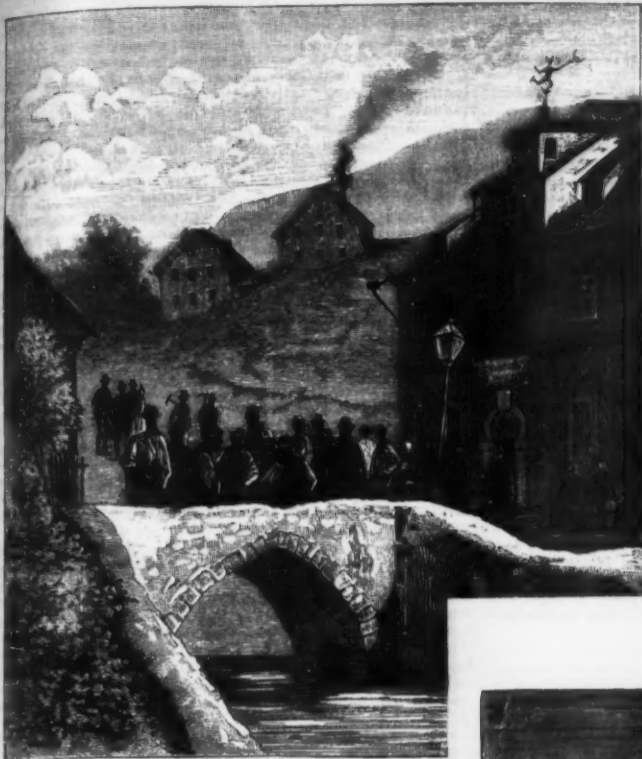
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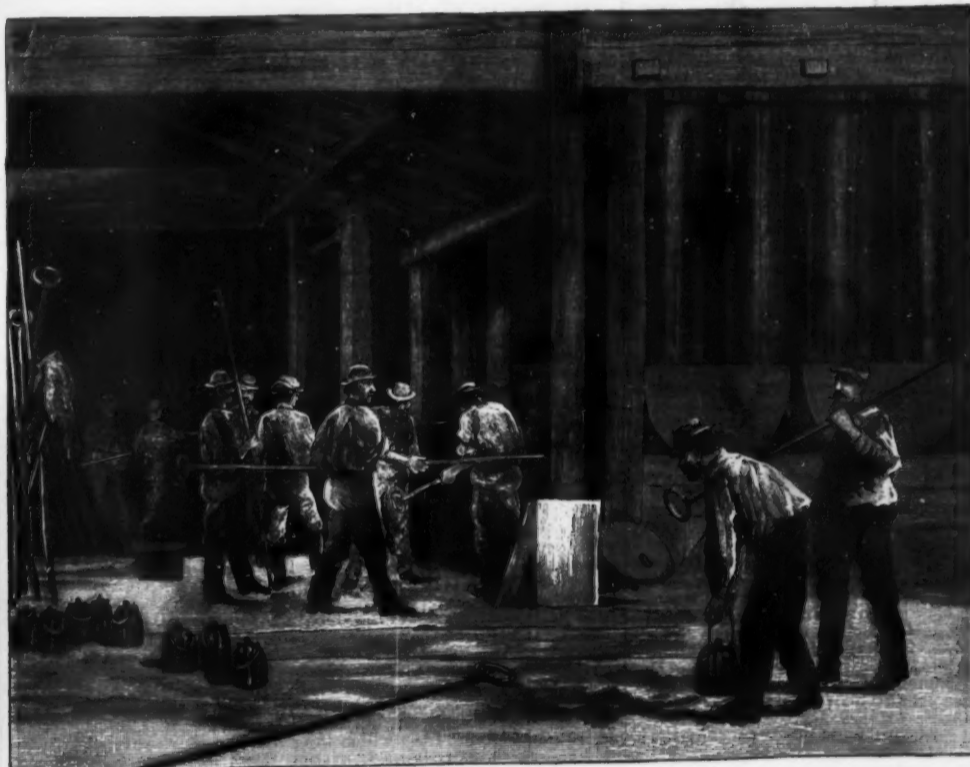
1. The Antoni-Stollen.



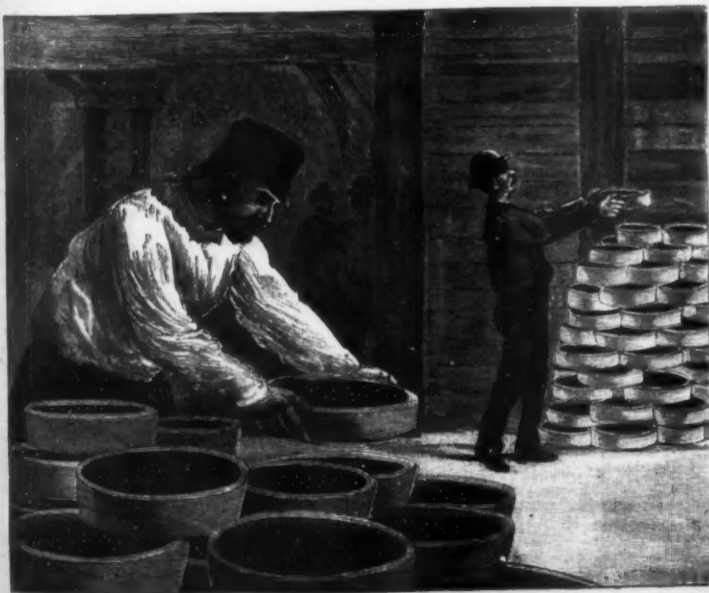
2. Native Silver in the Gallery.



3. Castle Gewerkenegg.



4. Cooling Apparatus in the Foundry.



5. Stacking the Stupp Vessels.



6. Filling the Iron Flasks with Quicksilver.

THE IMPERIAL QUICKSILVER MINES AT IDRIA, AUSTRIA.

falls like fine rain in the condensation chamber, from which it is conducted through channels to iron vessels, and from these it is poured into iron flasks for shipment. The loss of mercury when treated by the new methods, as compared with the old, is reduced to a minimum, and the effect on the health of those employed at the smelting works is much less injurious than formerly.

A peculiarity of the smelting process at Idria is the appearance of *stupp* in the furnaces. This is a mixture of metallic quicksilver, hydrocarbons, and quicksilver salts. It is collected in receptacles, the metallic quicksilver is extracted by pressure, and then the residue is mixed with lime and treated in a reverberatory furnace.

The production of cinnabar forms an important feature of the work at Idria. A description of the process would require too much space, so we will simply mention the fact that the cinnabar, as well as the three kinds of vermilion—the light red, the dark red, and the Chinese—which are produced at Idria are of excellent quality and in great demand.

The state has taken great precautions for the welfare of the workmen at Idria, but, unfortunately, has been unable to prevent the diseases caused by working in mercury, although their injurious effects have been reduced materially, as we have already stated, by improved bathing houses, leaves of absence to sick workmen with a continuation of their pay during their absence, and the supply of good food by the company. In 1879, of 163 pensioned workmen, 68 per cent. had served for forty years, and one was over ninety years old, seven were between eighty and ninety, forty-six between seventy and eighty, and eighty-five between sixty and seventy. The number of workmen now exceeds 1,000, and although the number is so great perfect order always reigns among them, which certainly speaks well for the management of the company.

We have only a little more to add in relation to the production of the works. From 1819 to 1881 they brought to the state a net profit of about \$9,398,702. In 1874 the profit reached as high as \$800,000, in consequence of the extraordinary advance in the price of quicksilver, and there will probably be a still greater advance, as the mines in California seem likely to be exhausted within a few years by bad management.—*Illustrirte Zeitung.*

WASTED SUNBEAMS—UNUSED HOUSE TOPS.

By GOUVERNEUR M. SMITH, M.D., New York.

HUMAN habitations, though erected for the benign purposes of insuring comfort, affording protection, and promoting family privacy, are, unfortunately, often the causes of a number of the morbid ills from which mankind suffer. This fact is true, as relating to the residences both of the rich and of the poor. It is a difficult task to construct an absolutely sanitary dwelling. In nearly every home, however, there are more or less avoidable insalutary conditions which are undermining the health of each family circle.

Tent life, in genial climates, affords to many a healthful mode of living; and tent life, in the warm season of the temperate zone, has its fascinations and its beneficial results. To be tabernacled under canvas and engaged in open air occupations is often healthful; but the camp must be well sited, or the proximity of unkind neighbors, as cesspools, fens, and polluted water, will as surely rob the camp dweller of his vitality as the footpad will rob the unguarded of his treasures. Camp life, salutary as it may often be, is not adapted, from climatic and other causes, to meet the necessities of universal home requirements.

History tells us that certain nomadic tribes, in the early ages, finding aggregation and permanency of residence desirable for business and other purposes, built solid structures, and, striking their tents, have thenceforth lived in substantial residences. From these primitive architectural styles of dwellings we can learn certain lessons which, if adapted to suit our own civilization and our own climate, would promote the health and longevity of our race.

The nineteenth century will ever be memorable for the advancement it has given to medicine, surgery, and sanitary science; but the twentieth century, when reviewing and profiting by the achievements of its predecessor, will doubtless be amazed that the domiciles of mankind, especially in cities, were in some respects inferior to those built several thousands of years previously.

The writings of Virgil, Horace, and other classical writers can be read with interest and benefit, at the present day, as teaching the style and erudition of an ancient period. In Xenophon's "Memorabilia," after describing how homes should be pleasant and useful, cool in summer and warm in winter, it is added: "If it is well, therefore, that houses should thus be made, ought we not to build the parts toward the south higher, that the sun in winter may not be shut out, and the parts toward the north lower, that the cold winds may not fall violently on them?"

Sacred writers offer important lessons also concerning Eastern habits of thought and customs regarding habitations, which can be utilized in a most profitable manner in the present age. The early Oriental had no conception of the nature of air or sunlight, as now understood by modern science. Probably much of our present knowledge is but polished ignorance. Chemistry and physics have only recently become efficient handmaids in the precise examination of nature, but without these aids the Eastern mind drew certain broad and grand deductions from the investigation of natural phenomena. Some of these tenets are axioms in our own philosophy.

These ancient forefathers believed that fresh air was an important factor in maintaining physical vigor, and that exposure to the solar beams was salutary, and they lived according to their convictions. In constructing their homes, their architects utilized their house tops and gave them salubrious plateaus. The roofs, gently declining as water sheds, were covered either with tiles, bricks, or cement, making them as durable as pavements. Beddings of turf, prettily distributed, made these artificial deserts to blossom as the rose.

The boundaries of each house were designated by walls, but it was possible to walk over an extended neighboring area. To prevent accidents, obedience was given to the scriptural injunction, "When thou buildest a new house, then thou shalt make a battlement for thy roof, that thou bring not blood upon thine house if any man fall from thence." It is not a matter of wonder that such house tops proved favorite places of resort for worship, conference, and repose, and that occasionally tents were spread upon them.

Is there anything either in our climate or state of civilization which prevents us from, in a measure, imitating such ancient, useful, and fashionable airiness? During the inclement season of the year, comparatively little use might be made of the house tops. I will subsequently allude to how the upper stories of dwellings might be constructed to catch the genial sunbeam, while shutting out winter's rudeness. Our atmosphere is proverbially bright, and many of the severer days are sunshiny; the genial element is subject to capture and benign use, as we can pluck quinine from its barkly surroundings.

In a great metropolis like this, there are thousands of children and invalids, to say nothing of those in mature years and engaged in the ordinary pursuits of life, who require more fresh air and sunning than is now practicable. City yards are small, shut in by tall buildings and high fences; the parks may not be adjacent, and the streets afford ill-conditioned pleasure grounds.

Cannot architectural ingenuity, coached by sanitary science, contrive some method of using the thousands of acres of house tops on this island so that roofs, now so useful in affording indoor protection from cold, sleet, and rain, can be made additionally useful, at certain seasons, by affording outdoor recreation and protection from invalidism? Cannot the same skill contrive new designs for the upper and most salutary stories of our dwellings; playing rooms and sunning rooms, especially adapted for the winter season, but so cleverly fashioned that too intense torrid beams can be excluded in summer?

The "solarium" of the New York Hospital, made attractive with its plants, birds, and aquaria, is a potent ally of therapeutics in restoring the convalescents, and at the Hospital for the Relief of the Ruptured and Crippled, the contagious sparkle of the sunbeam is found shining in the eyes and lives of the young patients.

Physicians must infrequently have occasion to observe the arrangements and conditions of the upper floors in our first-class private dwellings; for if a servant is sick, the family physician may be summoned to attend. The conditions may not be absolutely pernicious, but the space on these precious stories might be utilized in a much more healthful and attractive way. The heated and vitiated air from the lower part of the house rises to the top floor, with perhaps slight provision for its exit, and here are found servants' and storage rooms, and also often a dark closet, with precipitous ladder leading to the settle, rarely entered and ascended, except by workmen to repair the roof. Apartments for domestics have to be provided for, but quarters for trunks and unused articles, rather than occupying choice space, could be centralized in the building, be lighted from above, or relegated to some special annex in the yard.

In the ordinary and more spacious private dwellings the upper floors could be revolutionized: ventilating shafts introduced, new broad windows running the width of the house both front and rear, rearrangement of space, ready accessibility to the roof afforded, and at least a part of these floors made attractive to children and invalids as a bright, airy, and healthful resort. The limits of this article forbid giving details of such construction, and other collateral suggestions, making such changes practicable.

It is beyond the scope of this paper to point out all the evils attendant upon modern homes; one evil to which I am specially alluding is that of etiolation. Etiolation, while favorably regarded by farmers in rendering celery white, crisp, and tender, is not favorable in regard to bringing up human beings.

Not many years ago, for a time, it was widely customary here to hang blue-tinted glass panes or sashes in windows, curtains were drawn back, and many a room, from which the winter's sun was ordinarily, for the most part, excluded, was now brightened. Invalids and others basked in the shiny genial, and apparently with benign effect. Was such effect attributable to the mere azure tint alone, or to a salutary and unaccustomed hyemal basking?

In many of the lofty and palatial apartment houses in New York, comparatively fireproof, wealth selects suites of rooms near the apices, the air being drier, purer, brighter, and healthier than near the ground. It seems very clear that even private dwellings, occupied by single families, are not planned in the wisest manner.

Equally new attention should be paid to a utilization of the roof for a large part of the year. The city boy of to-day wishes to fly his kite. As a special privilege, parental consent is given to his going upon the house top; but with what injunctions! Precautions against falling off, that he take feline steps, or the paint will be scratched and the joints of the thin tin covering will be cracked and the roof made leaky, etc. As illustrating present inaccessibility to the roof: During the recent large fire at Forty-second Street and Lexington Avenue, a party of ladies in one of the fine houses on Murray Hill endeavored to go on the roof, to witness the adjacent conflagration. One of the ladies became wedged in the narrow passage. She survives, to grace her family, and to tell a humorous experience.

Roofing can be contrived suited to this climate, and enduring as pavement. A pleasure resort might ornament each residence, its limits bounded by the area of the dwelling; neighborly consent could widen the range, turf and flowers brightening the plain. Iron-framed and glass-enclosed rooms, or cupolas, could be added, which would prove useful during all seasons, artificial heat tempering brumal inclemency.

If such adaptation of house tops would be an advantage to the affluent, who can escape city life during the summer, how much greater advantage would be secured to the tenement house districts. It would be more difficult to preserve roofs in the latter quarters in good order, but the public weal seems to demand that ingenuity should devise an adamant roof covering. The promiscuous mingling on house tops of the residents of slums, freed from police restraint, might at times lead to mischief; but ordinarily, and over a large area, it is reasonable to believe that the innate proprieties of life would prove an all-sufficient constabulary influence. For the higher grade of tenement

houses, such fresh air facilities would probably be hailed with delight by the inmates. The proximity of open breathing places to their rooms would endear their humble homes. Summer moonlight evenings could have a new aspect; and, again, round a family lantern, groups might gather to read, sew, or engage in games, and thus a home-felt pleasure could quiet restless spirits, craving questionable or illicit amusements. More true enjoyment might be observed in such groups than on the piazzas of fashionable resorts. Landlords could arrange for the periodical sweeping of roofs, as well as the halls and stairways, and among a very large class of respectable poor, pride would stimulate to a tidy and decorative care of their home parks.

The confirmed vicious and degraded classes would neither appreciate nor properly use such improvements if offered them. In turning to higher grades of humanity, we find an aristocracy permeating even the lower million. In the same tenement house social distinctions may be observed among families, obstructing intimate domestic intercourse and cordial, friendly co-operation; but a well recognized common weal would doubtless link such diversities into a sufficiently harmonious and democratic unity of action.

I have thus pointed out what advantages to health might be secured by a rearrangement of the upper stories of private dwellings, making them the most salutary in each residence. I have also shown how the house tops of both the opulent and of the poor might be adapted for the private and public welfare of mankind, especially in cities.

Architects have merely to study ancient history and modern science to utilize the suggestions here made. Sunbeams and oxygen have been running to waste long enough. People must congregate into cities, and such crowding together must necessarily preclude, in a measure, some of the most salutary ways of living. The poet has said, "God made the country, and man made the town;" but the Divinity who so beautifully fashioned the country brightens both His own handiwork and the town with the same sunlight, and aerates with the same atmosphere.

Cannot cities more generously use nature's benign gifts? Cannot the closing years of the nineteenth century witness a revolution in the construction of dwellings, a change in the habits of city life, and a most notable improvement in the health of the people?—*Medical Record.*

REMEDY FOR IVY POISONING.

To the Editor of the Scientific American:

Being a constant reader of your valuable paper, I have noticed in it various cures for the troublesome poisoning by poison oak or ivy. I was for fifteen years a timberman and raftman in the swamp lands of the lower Mississippi River, and have been poisoned a number of times and have seen hundreds of others in the same condition.

These, as well as myself, I have cured with not more than two applications of my remedy, which I consider infallible. The first time, I was poisoned on arms and face, and was five days before I got relief. My eyes were closed by the swelling, so that I could not see. I bathed the parts with the lotion at night, and the next morning considered I was cured, although I applied it again in the morning. The lotion allays the itching almost instantaneously.

Five cents' worth of sugar of lead dissolved in one ounce or less of soft water will cure or kill as much poison as the water or lotion will cover. The sugar of lead should not be dissolved until necessary for use.

O. C. WHITE.

Wichita, Kansas.

C. R. AGNEW, M.D.

CORNELIUS REA AGNEW, M.D., died in this city on Wednesday, April 18, in the fifty-eighth year of his age, after an illness of only a few days' duration—a peritonitis, understood to have originated as a typhilitis.

The deceased was a native of New York and a graduate of the College of Physicians and Surgeons, of the class of 1852. For a few years he was a general practitioner, but the greater part of his professional life was spent in the practice of ophthalmology and otology, in which department he was one of the first in New York to arrive at eminence.

At various times he occupied numerous positions of distinction in hospitals and in medical societies, he was for many years the clinical professor of ophthalmology and otology in the College of Physicians and Surgeons, and he may almost be said to have created the strictly professional work that he was known so much as by the devotion and intelligence with which he taught his fellows the duties of citizenship. Although the extent of his services in this direction was known to only a few, enough of them was known to secure his general recognition in New York as one of the most respected of her citizens. Perhaps the most far-reaching work of his life was what he accomplished as one of the organizers and working members of the United States Sanitary Commission. The commission was materially aided in its operations by his industrious labor, and guided by his wisdom. It is no more than the simple truth to say that every sick man and every wounded man in the Union army had his condition alleviated, so far as mitigation of the horrors of war was possible, by appliances that were largely due to Dr. Agnew's forethought and executive skill. In another sphere, as one of the trustees of Columbia College, his efforts to improve the institution were constant, and it is not to be doubted that they had much to do with bringing about the very decided advances made by the college during the last few years; and in a like capacity on the board of the College of Physicians and Surgeons he worked intelligently and zealously for the advancement of medical education in New York. In his devotion to the public interest he did not disdain to concern himself with political discussions and contests—never as a partisan or with any motive looking to his own advantage, but always as a source of light to those who were right at heart but perplexed in mind. In whatever sphere he acted, he always influenced men's minds powerfully, but, although he was a speaker delightful to listen to, he never resorted to oratorical devices, and seldom even

to parliamentary tactics; it was rather his clear, cold logic, his evident fairness, and his unquestioned devotion to the general welfare that gave him his power in debate. Consequently, he never worked his hearers up to the point of voting under the influence of passion, and they never repented of having heeded his words. It long ago came to be understood in New York that Dr. Agnew's advocacy of any movement was *prima facie* evidence that the movement was a good one. To be sure, not every cause that he supported triumphed—occasionally intrigue, and on one memorable occasion medievalism, proved too much for him; but never did an opponent indulge in innuendo against Agnew without writing himself an ass. He was a man whose course it was never necessary to explain; he was *sans peur et sans reproche*.

Personally, Dr. Agnew was a man of wholesome and attractive appearance. His glance was clear and penetrating, but kindly. He played the mentor to many a restless or misguided spirit, but his advice was given only when it was invited, and it always savored more of affection than of rebuke. With the community, with his professional brethren, with his patients, with his personal friends, and in his family, he was a remarkably exemplary man. His loss is that not only of the New York profession of medicine, but that of the entire people.—*N. Y. Med. Jour.*

EMIN BEY (DR. SCHNITZLER), GOVERNOR OF THE PROVINCES OF THE EQUATOR.

THE portrait of Emin Bey published herewith is one of the most rare and curious of the documents of the Geographical Society of France, who have loaned it to

THE GREAT AMERICAN PYRAMID AND RUINED CITIES OF ARIZONA AND NEW MEXICO.

(From the correspondence of the Boston Herald.)

CHOLULA, State of Puebla, Mexico.—One does not have to leave North American soil to visit a genuine pyramid, which will compare in size with the Pyramid of Cheops itself. In fact, one might start from the door of the *Herald* office, and, taking the street cars to the Albany depot, ride, without scarcely getting off the steel rails, to the base of the famous Pyramid of Cholula. In nine days and nights from the *Herald* doorway one would be on this spot, in the midst of artificial and natural wonders nowhere on this continent to be surpassed. To get here one must needs come over the Mexican or Vera Cruz railway, as it is more commonly called, and by its branch at Apizaco to Puebla, whence a horse railway leads to Cholula, about eight or nine miles distant.

Nobody knows—even the most acute modern archaeologist—just when this pyramid was built. It is certain that the Aztecs saw it when they invaded this land and wondered at it. Probably the Toltecs, or the Omtecs, had a hand in its construction, but all this may be well left to the curiosity of the learned and to the zeal of grubbers into the dusty and misty past.

Before I came here, I will confess that I had little faith in the theory of a pyramid, the existing photographs of it not giving one much other idea than that of a huge mound of earth; but, since coming here and examining minutely this marvelous ruin, I have grown to wonder at the skill and energy of the American pyramid

the sea in ancient times to teach the Aztecs the arts of civilization. There is some ground for supposing that this mythological personage was a Christian missionary who found his way from Greenland—in old times a fairly civilized land—to Mexico, who lived with the forefathers of the later Aztecs and taught them many arts. He was called "the god of the art;" his statue was crowned with a golden mitre, he wore a gold collar, turquoise earrings, and carried a scepter studded with gems, and a shield painted with emblems of the four winds.

Mr. Bandelier thinks that the Pyramid of Cholula served both as a fortified place and a site for worship. At the top was a temple of the gods, and on the terraces were dwellings—the whole making a fortified pueblo. At the time of the conquest, in cutting off an end of the pyramid to make room for a more direct road from Puebla to Mexico, a vast hollow chamber under the structure was disclosed to view. It was built of stone and sustained by beams of cypress. In it were two skeletons, some idols, and a large number of glazed vases. It is said that this chamber was not open, but was covered with brick and clay, and had no outlet whatever.

The Mexican pyramids here at Cholula and at Tula resemble marvelously the Assyrian and Chaldean temples which Layard and others have minutely described. The whole subject is full of interest, and American antiquarians will find here and elsewhere in this country a rich field for their researches.

From the top of the pyramid one discerns on the plain below some curious mounds, one somewhat resembling an elephant, all unmistakably artificial, showing that this region was once a religious gathering ground, a sort of American Mecca. I would be glad to have the time needed for a minute survey of this section, but one should have abundant leisure and experience in antiquarian matters.

The early Spaniards made all haste to exorcise the "devils" of the religion of the conquered race. They built many churches here, and it is a fact that in Cholula itself there are to-day churches and chapels to the number of 365—one for each day of the year. One church, built by order of Cortez, is most curious in its architecture. It has low walls and a Moorish aspect, and is said to have been built to resemble the famous mosque of Cordova. In the time of the Aztecs there were 40,000 inhabitants in Cholula; now not over 6,000. It was at Cholula, in its vast square, that Cortez, in 1519, perpetrated a wholesale massacre.

A great many interesting relics are to be bought there, and the natives ply quite a trade in the selling of miniature idols dug up all around here. There are skeptics who say that there are regular little idol factories where good imitations are made, but I think that many of the little relics to be had here are undoubtedly genuine. There was a great religious gathering place, a place for pilgrimages, and idols were in ancient times made here in vast quantities. So the traveler, exercising a proper amount of caution, may buy freely, first examining the articles offered for authentic marks of age.

But the pyramid, wonderful as it is in itself, is dwarfed into insignificance by the huge mountains which form a vast wall separating the valley of Puebla from the valley of Mexico. From the top of the pyramid here, I note a good sized hill lying up under the base of Popocatepetl. It looks like a sailboat alongside of the Great Eastern. In other directions one sees Malinche, the most curious of mountains, and the lofty, "star shining" peak of Orizaba. Nature has here spread out a panorama which should bring artists here by scores. But only on a great canvas can this scene be adequately portrayed.

The comfortable way to "do" this valley and Cholula is to make your temporary home in this nearby city of Puebla, where, as I noted in a previous letter, a good hotel can be found at the Diligencias, where there is good food and no vermin. Puebla makes a good headquarters to go from to visit not only this place, but the strange little town of Tlaxcala. And of Puebla itself, one who is fond of characteristic Spanish architecture, of Spanish scenes and life, cannot quickly get tired. Its sweet air is as balm to the lungs, and is strengthening and appetite provoking. The old-book hunter and the curiosity collector will find Puebla worth a fortnight of his time.

The more I see of this country, the stronger grows the impression that Mexico is to become to the United States and its hurried, overworked, and nervous population what Italy is to the rest of Europe—the land of winter journeys, of health residence for those broken down with the strenuous, rushing life of the great northern republic. Mexico is but little part known; it is on its vast stretch of high plateau, a land of wonderful climate, the sanitarium of this continent. The robust health of the table-land rancheros, who sit their powerful horses like centaurs, vindicates the climate and disproves the flippant assertion that no strong race ever existed on an elevated plateau.

American physicians who want to be up with the times should make a study of characteristic Mexican climates for the information of health-seeking people. The climate of a tropical town like Orizaba is, for example, very different from that of this plateau region. At Orizaba there is a summer all the year; here, in winter there is a continual October of bright days, blue skies and crisp air. At Cuernavaca, Morelia, and such places, there is a mild, May-like climate. At Lake Patzcuaro, at the present terminus of the Mexican National Railway's Pacific division, there is a lovely climate, a lake which no Italian sheet of water can surpass in beauty, which has elicited the praise of America's greatest painter, who makes his winter home in the charming city of Morelia.

I am surprised that none of the railway companies has taken practical steps to make known the virtues of the many-climated sanitarium that Mexico affords. The neglect of the dissemination of this sort of information indicates the sluggishness of apprehension of the managers. A pushing, working corporation would long before this have made Mexico as well known to every American as Italy is to the European. A few newspaper correspondents have done the work, in part, which should systematically have been accomplished by the railway companies.

A land without snow or ice, *sans tempests* and dull days, with a sun which makes all out of doors a perpetual October, ought to attract thousands of American pilgrims yearly. By sea and land routes, offering many attractions, this country may be reached. By



EMIN BEY (DR. SCHNITZLER), GOVERNOR OF THE PROVINCES OF THE EQUATOR.

us. It is probably the only one in Europe. This is the history of it:

M. L. Vossion, at that time consul of France at Khartoum, received a visit from Dr. Schnitzler, known commonly as Emin Bey, during March, 1882, and at that time took his photograph, which, after his return to Paris on the 4th of August, 1882, he presented to the Geographical Society. M. L. Vossion, who is at present consul of France at Philadelphia, Pa., remembering the above, and the importance imparted to the unfortunate Emin Bey by his position in the depths of the desert, defending himself against the adherents of the Mahdi, with a handful of men, wrote to his colleague, Mr. James Jackson, librarian of the Geographical Society of Paris, to beg him to make known the existence of the photograph.

The photograph in question is carefully preserved in one of the albums of the Society. The reproduction was obtained at night with gas light, with a Dallmeyer objective with a diaphragm 0.0053 m. on a plate with 30 minutes' exposure.

Emin Bey succeeded Gordon Pasha in 1882 in the government of the Provinces of the Equator. He resides at Ludo-Gondokoro, whence he visits the Niamas, the Yomboutous, the Latukka, the Uganda, and the Ungoro.

To paint a black eye there is nothing to compare with the tincture of Capsicum annuum, mixed with an equal bulk of mastic of gum arabic, with the addition of a few drops of glycerine. The mixture should be painted over the bruised surface, a second and third coating being applied as soon as the first has dried. If applied immediately after the injury is inflicted, it will almost invariably prevent discoloring of the tissue. The remedy is also of value in rheumatism, sore of stiff neck.—*Chem. and Drug.*

builders. Who they were, what they were, why they built this huge structure—all these are questions which stir the imagination. Certain it is that, at a time when northern Europe was barbaric, a cultivated worship, a civilized race, inhabited this land of the ever-shining sun.

The huge artificial structure which rises abruptly from the surrounding plain is crowned at the top by a pretty church, which is dedicated to Our Lady of the Remedies, built by the Spaniards on the site of the former Aztec temple which the conquerors found there. The measurements of the pyramid differ; Humboldt giving the sides of the base at 439 meters each, and Bandelier, who was here quite recently, making the north side 1,000 feet, the east side 1,026 feet, the south side 833 feet, and the west side 1,000 feet. The height is about 144 or more feet from the base to the topmost terrace, on which stands the church. A view which Humboldt gives shows that formerly the four terraces of the pyramid were very distinctly to be seen, but now, owing to the crumbling of the sharp edges of the terraces by the action of rain and time, the pyramidal aspect is not so immediately to be discerned. But a near view and not very minute examination shows at once the artificial character of the mound. Going up the broad paved road, which winds around to the top, you see cuttings where the adobe brick, of which the structure is principally composed, is disclosed to view. The mound was built of adobe, or baked earth bricks, limestone in fragments, gravel, or rather pebbles, and bits of lava. The steps leading from the base to the temple were made of limestone slabs. All the materials came from near at hand.

In the time of the conquest a temple, built by the Aztecs, topped the structure. This house of worship was dedicated to the mysterious fair, white god Quetzalcoatl, of whom tradition is that he came from over

sea one may arrange to stop off at Nassau and traverse Cuba longitudinally, and thence to Vera Cruz. By land the Central offers a route lying through great Mexican cities, Zacatecas, Leon, Guanajuato, etc.—
F. R. G.

MARVELOUS DISCOVERY IN ARIZONA—A CITY THREE MILES LONG.

LOS MUERTOS, ARIZ., Dec. 26, 1887.—The Hemenway expedition, under the direction of Frank Cushing, has been at work for several months, and has excavated the ruins of a city three miles long and two miles wide. The excavations are not continuous, but have been made at various points along the main street and at the limits of the town. Mr. Cushing acquired from the Zuni Indians, among whom he has lived for some years, the knowledge of customs and traditions which enabled him to find the buried cities of the Salt River valley. The first one excavated is called Los Muertos, the city of the dead. Others that have been partially excavated are El Pueblo de los Hornos, the city of ovens; El Ciudad de los Pueblitos and El Pueblo de los Pedros. But these are only a part of the chain of cities that once covered the desert. There are nineteen buried cities in the valley alone, and Los Muertos, which had a population of ten thousand, is one of the smallest.

The entire valley was once a system of cities, with adjacent farms, and up in the mountains are sacrificial caves and pueblos of stone, many of which have never been explored, and are entirely unknown to the wondering tourist and sightseer. The people who lived in these were not Aztecs, as has been supposed. They were of the race that preceded the Aztecs, and had upon this continent a civilization older than the pyramids. This is proved by the human remains and relics found. Ethnological researches, prosecuted by Mr. Cushing by the comparative method, demonstrate that the dwellers of the plain were Toltecs, and that they reached a high state of civilization many centuries before the Aztecs appeared. They were probably of

\$2,500,000. No less than 450,000 acres were cultivated in the Salt Lake valley by means of these ancient ditches.

The Toltecs had no occasion to raise more corn than they could consume, and, therefore, the population of the plain may be calculated on the basis of cultivated acreage. The 4,000 Pyma Indians on the 1,000 acres support themselves and sell 9,000,000 pounds of wheat yearly. It is within bounds to place the ancient population at 250,000.

The ruins still uncovered, but traced by unmistakable surface indications, extend through the foot of the hills into the mountains. The ruins of Los Muertos are being thoroughly examined, because they are typical, and also because they have been buried, and, therefore, protected from the ravages of time, tourists, and ranches. Twenty-two large blocks of building have been uncovered, and three car loads of relics have been sent to Boston. These relics consist of pottery, implements, and skeletons.

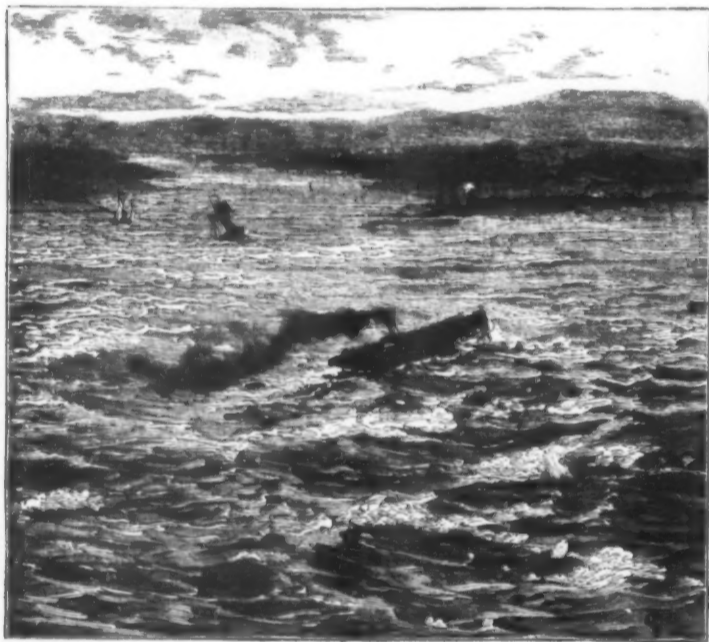
One of the ruined buildings is 400 by 375 feet, another is 480 feet long, and many of the buildings are 300 feet square. The adobe walls are sometimes seven feet thick and two stories high. Connected with each building is a pyral mound, around the base of which are the funeral urns containing the ashes of cremated Toltecs. Entrance to the buildings was sometimes through doorways and sometimes through holes in the roof. Each building was divided into a great number of small rooms, indicating a large population to each block. The roofs were of concrete, supported by timber, and most of them have fallen in. Here and there the concrete remains in position. It is evident that these cities were destroyed by earthquakes. In most cases the roofs have fallen in and the side walls have fallen outward. Time has disintegrated the adobe blocks, and the rains have spread the material so evenly that the buildings are indicated only by slight irregularities in the surface. The work of excavation is simply to clear away the surface material. That the cities were suddenly overthrown is proved by the finding of skeletons under the fallen roofs and walls in

the relics unearthed: "They found the remains of several human beings, several handsome vases carved with geometrical figures in different colors, stone axes, hammer, pieces of cloth apparently manufactured from the fiber of yucca, several strings of beads, sea shells, arrow heads, an abundance of fragments of obsidian quartz, and an incredible quantity of pieces of broken pottery, including several with a blue glazing. Only in one other instance have we ever heard of this color and quantity of ware having been discovered in this Territory, and that was at the ancient pueblo near the Santa Rita, in this country, and it indicates that the Spaniards had lived in New Mexico before the extinction of the race who inhabited this ruined and buried village."

The miners do not know whether they tapped the best or the poorest spot in their buried town in this first excavation. They have, however, resolved to continue digging. They are of the opinion that they may be able to unearth a cabinet of curios, the sale of which will bring them more coin than they would make in the same time at prospecting for precious metals.

TUXPAN, MEXICO.

OUR illustrations are from sketches by Mr. S. E. White, who writes: "I am much impressed by the situation of Tuxpan as a rising port, in the Mexican Gulf, which might supersede Vera Cruz, on account of its healthiness, good anchorage, and fine river. The only drawback is the difficult bar at the mouth of the river, but this could easily be removed by the construction of two piers, such, for example, as exist at Boulogne-sur-Mer. The clearance, moreover, would be easily effected here, owing to the great volume of water which pours down from the mountainous regions some 100 miles distant, and which for 30 miles is 500 yards wide and 30 to 40 feet deep. When this work is accomplished and the proposed railway constructed, Tuxpan would be brought some seventy miles nearer to the capital than Vera Cruz, and would greatly aid the development of one of the finest countries in the world and



THE BAR AT THE MOUTH OF THE RIVER, LOOKING TOWARD TUXPAN FROM THE GULF OF MEXICO.



VIEW OF THE CITY OF TUXPAN FROM OBSERVATORY HILL, LOOKING WEST.

THE CITY OF TUXPAN, A RISING PORT OF MEXICO.

Asiatic origin, but not Mongoloid. The Indian of the Pacific coast appears to be Mongoloid and a later immigrant from Asia. The age of the Toltec ruins is reckoned in thousands of years. The Toltecs were agricultural people, and had the plain of Tempe under a high state of cultivation. The climate and character of the soil were, apparently, the same as now, and a vast system of irrigation was required to make the land productive. The maps made by the surveyor of the Hemenway party show at least three hundred lines of ditch work.

The Toltecs were better irrigators than farmers of to-day. They were satisfied with a very slight flow, and, consequently, were able to conduct water to every part of the plain. The higher ground, which is now a desert, was reached by levees upon which the water flowed. The bottoms of these ditches and levees, hardened by the water flowing over them, have resisted the leveling power of the elements. The banks have disappeared, leaving the bottoms elevated slightly above the plain, and these hardened surfaces are now used as roads all over the valley. In some places the irrigating canal was cut through the solid rock with stone implements. The cost of making that cut to-day with improved implements would be \$20,000.

The manner of building the ditches and keeping them in repair is indicated by two parallel rows of stones along the sides of the ditches. These stones are of diorite, and were used as chipping stones to sharpen the stone implements with which the digging was done. Most of them seem to have been worn out and thrown aside, and probably they were covered up with earth and thrown out as the work advanced. The washing away of banks by the rains of centuries has left them exposed. Many, no doubt, were used in repairing the banks. The natural inference is that the ditches were maintained during a long period. The modern canal system of the valley is only forty-one miles in extent and cost \$1,500,000. The Toltec ditches were of great size and extent, no less than 300 miles of canal alone, and could not be built to-day for less than

positions indicating violent death. One photographed as found shows that the man was caught under the falling roof and thrown upon his face. His chest is crushed forward by the weight, and his right hand stretched out as he fell. A large number of bodies found proves that the calamity was widespread and complete.

In one of the sacrificial caves of the Superstition Mountains was a skeleton that eloquently tells the story of the earthquake and the terror of the inhabitants. It is that of a maiden sacrificed, as the vessels and offering on the altar show the ethnologist, to appease the wrath of the earthquake demon. There had been several shocks, and the people had offered up ordinary sacrifices in vain. At last the priest went up to the sacrificial cave and made the supreme offering of a maiden of the tribe. The people returned to their homes, assured that their danger had been averted. Then came the greatest quake of all. Those not caught in the ruins fled in terror to the fields. The gods had abandoned them to the malignant wrath of the powers of evil, that even to-day are believed by the Indians to dwell in the Superstition Mountains. They fled in panic, the Toltec people were scattered through the country, the wild tribes of the hills and forests made war upon them and drove them to the south, and a splendid civilization of prehistoric times was obliterated from the face of the earth.

AN ANCIENT CITY IN NEW MEXICO.

The Virginia City (Nevada) *Enterprise* says: "To the eastward of Socorro, New Mexico, two proprietors a few days ago accidentally stumbled upon indications of ancient ruins projecting above the shifting sands of the plain. A careful examination convinced them that beneath their feet, buried in the desert sands, lay the ruins of an ancient town. Turning to with their shovels to explore their find, a few hours' work brought them to the floor of a small room in the form of a parallelogram." The Socorro *Bullion* thus describes

afford employment to thousands of those unemployed of whose demonstrations in London I hear so much. Already the exports hence, to the United States alone, amount yearly to the value of 300,000, although all goods have to be shipped in lighters and small schooners which can cross the bar and carry them to steamers anchored outside."—*The Graphic*.

[THE SCIENTIST.]

ECONOMY OF NATURE.

If we look for the derivation of this word economy, we can trace its origin back to the Greek language. In its composition we recognize in the first three letters the word which means "house," and in the remaining letters the word for "law" or "usage." Accordingly, economy may be defined as the law regulating household matters. It also involves the idea of avoiding all waste, and of applying and using matter to the best advantage. A casual observer would testify that there is no law in nature; that there is much waste; and as a result—no economy. But the observant man, aided by his judgment and experiments, finds perfect economy throughout all nature. Everybody is aware of the truth of this last statement in the conversion of one force into another. The child pounding a stick with a hammer soon learns that this energy has not only splintered the stick, but caused it to become heated. The friction of revolving belts on pulleys not only produces heat, but electricity, which in turn produces magnetism. And thus one form of energy, apparently lost, may be changed into another form. Again, in the structure of the bones of animals and the stems of plants, we find this economy illustrated: for they are built so as to gain the greatest strength with the least material; since each is a hollow cylinder. This gives lightness, strength, and beauty of form. Another example of economy is seen in the arrangement of the leaves, buds, and limbs of trees. The alternate arrangement stands first, where there is one leaf at each joint.

The opposite arrangement follows, where there are two leaves at each joint, and each two consecutive pairs are at right angles to each other. The third method is the verticillate, where more than two leaves are found at each joint. This last method is illustrated in the leaves of the Indian cucumber or the branches of the pine trees. The opposite method is illustrated in the maple and ash. But the greatest variety is seen in the alternate arrangement. The simplest variety is where one leaf is upon one side, the second is above it, but just half way round the stem, and the third directly above the first. The elm will illustrate this variety. A second variety is where (starting with any leaf as the first) the second leaf is one-third of the distance round the stem, the third leaf two-thirds of the distance round the stem, and the fourth directly over the first. This arrangement gives an angle of 120 degrees between every two successive leaves, and as one looks from end to end of a branch, he finds the leaves in three rows, while in the former variety they are in two rows. Thus we have the two-ranked system, the three-ranked, the four-ranked (illustrated by the opposite arrangement), the five-ranked, which is illustrated by most of our trees; but some plants give the eight-ranked and the thirteen-ranked varieties. Now this gives the greatest possible amount of space to each leaf, as well as securing the greatest amount of sunshine, and at the same time affording symmetry. One of the most striking examples of economy in nature is that which takes place between the vegetable and animal worlds. The animal world inhales oxygen which unites with the waste particles of the system, and, brought by the blood to the lungs, is exhaled as carbonic acid gas, which is destructive to all life and combustion. This poisonous gas is taken up by the roots of plants with other ingredients, carried by capillary attraction to the leaves, where, by the sun's rays, the carbon is separated to form the wood, and oxygen is liberated to again repeat its round of usefulness. And so, universally, nature's economy is perfection. Nothing is allowed to waste.—E. Adams Hartwell.

THE PTOMAINES.*

By Prof. A. P. LUFF.

THE author stated at the outset that he had selected the subject "The Ptomaines" for a discourse because it occurred to him that an account of these bodies, which have been so comparatively recently discovered, and which, even at the present time, are so little known, would be of interest, and it struck him also that he might perhaps be able to give his hearers an insight into the vast benefit that may possibly result to mankind by a closer acquaintance with, and a more accurate knowledge of, the properties of these peculiar compounds, and that by a few speculations of his own he might point out the role that they may be destined to play in the drama of life in the future.

I propose, he continued, to discuss the subject under the five following heads:

- (1) What are "ptomaines"?
- (2) From what substances, and under what conditions, are ptomaines formed?
- (3) What is the chemical constitution of the ptomaines, and to what other bodies are they related?
- (4) What are the properties of the ptomaines?
- (5) What possible importance may a knowledge of the ptomaines assume in the future?

I. Ptomaines are alkaloids produced by the decomposition of animal substances. By the term "alkaloid," as generally employed, we understand "an organic base derived from a vegetable source;" by the term "ptomaine" we are to understand "an organic base derived from an animal source." The word "ptomaine," which is derived from *ptoma*, a corpse or dead body, and *inus*, belonging to, was at first restricted to alkaloids produced by cadaveric decomposition, but is now also employed to designate alkaloids of animal origin formed during life, as a result of chemical changes induced by some agency or other acting within the organism. The term "leucomaine" has recently been introduced to particularize the animal alkaloids formed during life from those produced by decomposition of dead animal matter. I shall not, however, in this paper use that term much, as the name "ptomaine" is more familiar, and, moreover, it is probable that in the near future the terms "ptomaines" and "leucomaines" will be dropped, and that these bases of animal origin will be classed in one category as "animal alkaloids."

II. At the beginning of this century the power of plants to form alkaloids had been conceded, but until 1873 the power of manufacturing alkaloids was believed to be restricted to plants, and not to be shared by animal organisms. The first faint foreshadowing of the production of alkaloids by animal substances occurred in 1830, when Kerner pointed out the resemblance between the symptoms of poisoning by sausages and by atropine. In 1823 Gaspard and Stick extracted a venomous principle from corpses. In 1856 Panum detected a very active poison, which was neither albuminoid nor alkaloidal, in putrid matter. In 1866 Dupre and Bence Jones found an alkaloidal substance, resembling quinine in some of its properties, in the liver. In 1868 Bergmann and Schmiedeberg obtained from putrid beer a nitrogenous crystalline substance, which they called sepsine, and which was subsequently thought to be discovered in septicemic blood. In 1870 Gautier, in France, commenced his researches on putrefying albuminous substances. A little later Selmi, in Italy, examining the dead body of a person supposed to have been poisoned, extracted an alkaloid which he was unable to identify with any known body, and was led to suspect that it had been produced after death. In 1877 Selmi announced that by subjecting pure albumen to putrefaction he had been enabled to produce and separate two new alkaloids.

Since then Gautier has made a series of elaborate and prolific researches, as the result of which several animal alkaloids have been discovered. To Gautier is due the honor and the credit of being the first one to demolish the artificial barrier that had been erroneously interposed between the physiological phenomena of the animal and vegetable kingdoms, and to clearly establish the doctrine that plants possess no

monopoly, no exclusive power to manufacture alkaloids. Creatinine, xanthine, hypoxanthine, guanine, carmine, and betaine, all genuine alkaloids, were found in the tissues of animals, or in their excrementitious products.

Creatinine, discovered in urine by Liebig and Pettenkofer, was the first body of animal origin acknowledged to be an alkaloid. Later Liebreich detected the already known vegetable alkaloid betaine in normal urine. In 1890 Pouchet detected carmine in human urine, and this was confirmed in 1881 by Gautier, who showed that it possessed the general properties of a ptomaine. In 1882 Bouchard demonstrated that not only were alkaloids present in appreciable quantities in normal urines, but that they augmented notably in the course of certain maladies—in typhoid fever, for instance; and later Lepine and Aubert concluded that these alkaloids in the urine increase in quantity until the crisis of the disease is reached, after which they diminish (no alkaloid was isolated by these workers in connection with any disease in sufficient quantity, or sufficiently pure, to admit of its ultimate composition being determined). Since then Gautier, as the result of his investigations, has affirmed that the incessant production of alkaloids at the expense of albuminoid materials is a function of all the animal tissues, and is an essential concomitant of the vital phenomena of all living things, animal and vegetable.

It is to albumen, then (a body alike present in animals and plants), that we must look as the common ancestor of alkaloids, whether animal or vegetable. Now, what is it that brings about those changes in the albumen molecule, that revolution among its constituent atoms, as the result of which follows the rearrangement of those atoms into other bodies, among which are the ptomaines? The force necessary to effect these changes in the albumen molecule is a vital force, a force intimately associated with living matter, whether animal or vegetable; for even in the case of the corpse alkaloids, the ptomaines produced by decomposition of animal matter after death, these bodies are formed as the result of changes induced by the vital activity of micro-organisms which set up cadaveric putrefaction. The changes induced in the albumen are such that the complex albumen molecule is split up into several less complex molecules, among which are the animal alkaloids. Albumen is almost insoluble in water, and quite insoluble in alcohol. Now, during its putrefactive destruction it passes through the three following stages:

- 1st Stage.—It yields products which are soluble in water, but insoluble in alcohol.
- 2d Stage.—It yields products which are soluble in alcohol, but are non-crystallizable.
- 3d Stage.—It yields crystallizable products, among which are ptomaines.

The following is a list of the principal ptomaines that have been extracted from putrefying animal matters and submitted to ultimate analysis:

- I. Non-oxygenous ptomaines
Belong to pyridine (C_4H_5N) series.
Collidine, $C_8H_{11}N$, from putrefying horseflesh and mackerel.
Parvoline, $C_8H_{11}N$, from putrefying horseflesh and mackerel.
Unnaked base, $C_{10}H_{13}N$, from putrefying fibrin of bullock's blood.
Hydrocollidine, $C_8H_{11}N$, from putrefying horseflesh and mackerel.
Putrescine, $C_4H_{11}N_3$, from human corpses.
Neuridine, $C_8H_{13}NO_3$, from human corpses, and from putrefying fish and cheese.
Cadaverine, $C_8H_{13}N_3$, from human corpses.
- II. Oxygenous ptomaines:
Neurine, $C_8H_{13}NO$, from cadaveric putrefaction.
Muscine, $C_8H_{13}NO_3$, from putrid fish.
Choline, $C_5H_{13}NO$, from cadaveric putrefaction.
Gudine, $C_8H_{13}NO_3$, from putrid cod-fish.

Recently Vaughan, in America, has extracted a ptomaine, named *typhotoxicon*, from decomposing cheese, milk and cream.

But, as I previously stated, not only are alkaloids produced from albumen by its putrefactive decomposition, but also by the chemical changes occurring within the organism during life. In my opinion the formation in the human economy of animal alkaloids will, in all probability, explain the genesis of many diseases. But not only in connection with disease, but every instant of our lives, are alkaloids being manufactured within us as a result of the chemical changes upon which life is dependent. Gautier has shown that animal alkaloids are a necessary product of vital physiological processes, poisonous alkaloids having been extracted by him from the secretions of living beings. The following is a list of the principal animal alkaloids so obtained:

- Creatinine*, $C_4H_7N_3O_2$, from urine.
- Pseudoxanthine*, $C_8H_9N_3O_2$, from urine and flesh.
- Sarkine*, $C_8H_9N_3O_2$, from urine and flesh.
- Xanthine*, $C_8H_9N_3O_2$, from urine and flesh.
- Crusocreatinine*, $C_8H_9N_3O_2$, from fresh meat.
- Xanthocreatinine*, $C_8H_9N_3O_2$, from fresh meat.
- Guanine*, $C_5H_7N_5O_2$, from flesh and guano.
- Carmine*, $C_8H_9N_3O_2$, from fresh meat.
- Betaine*, $C_5H_{11}NO_2$, from urine.

Alkaloids have been detected in the liver, brain, heart, lungs, spleen, and saliva of man; but these have not been submitted to an ultimate analysis, but only recognized by their reactions with the general reagents for alkaloids. The poisonous effects of certain shell fish (mussels, etc.) have been shown by Brieger to be due to a ptomaine which he has named *mytilotoxine*, $C_8H_9N_3O_2$.

As I previously stated, animal alkaloids are being incessantly produced within our bodies as a result of the normal physiological processes of life. Side by side with the manufacture and building up of fresh cell materials must go the destruction of pre-existing cell elements, and among the debris resulting from this destruction are animal alkaloids. These alkaloids are eliminated by the bowels, kidneys, liver, skin, and lungs; if from any cause these eliminating organs fail to perfectly fulfill their excretory functions, then an accumulation of these alkaloids in the circulation occurs, and a toxic action is exerted by them on the nervous centers. In this way can be explained the headache resulting from constipation, and the more serious nervous symptoms resulting from deficient excretory ac-

tion of the kidneys in certain diseases of those organs. But it is not only on these excretory organs that we depend for the removal of these alkaloids. A powerful agent is at work, destroying them and preventing their infecting and poisoning the being that gave them birth, in the oxygen of the blood, which is continually burning them up. With this new knowledge, is it to be wondered at that health is so precarious a condition as we know it to be, when we see that from imperfect elimination, imperfect destruction, or from increased manufacture of these alkaloids, the human body is at the mercy of these fell poisons manufactured within its own recesses? If, the enunciations remaining sound, there is still excessive production, but inadequate elimination—a condition which is obtained in all forms of over-exertion, as in a prolonged march—then accumulation of material elaborated in excess and imperfectly eliminated occurs, an auto-infection, a temporary poisoning of the system results, the poison affecting the nervous centers and producing the fever of over-exertion, the fever of prostration.

III. Ptomaines are divided into two classes, the non-oxygenous and the oxygenous. A few of them belong to the pyridine and hydropyridine series, showing a close relationship to some of the vegetable alkaloids. Those at present known all have simpler chemical formulae than the majority of the vegetable alkaloids. A number of the leucomaines have been prepared synthetically. Let us here consider the question as to whether the animal and vegetable alkaloids form two distinct groups. Is there any well defined frontier line between them? No; on the contrary, these two groups dovetail: they are inseparably linked together by certain alkaloids common to both. For instance, muscarine, an alkaloid present in the fly mushroom, has been found in putrid fish; betaine, an alkaloid contained in beet root, has been found in the urine of man; guanine and sarkine, two alkaloids found in flesh, have recently been detected in the young sprouts of the plane tree, vine, and other plants.

IV. Ptomaines are generally powerful poisons, the free ptomaines being more energetic than their salts; they are either solid or liquid bodies, very alkaline, uniting with acids to form crystalline salts. They are precipitated by the general reagents that precipitate alkaloids, viz., Meyer's solution, the double iodide of bismuth and potassium, phosphomolybdate of sodium, picric acid and tannin; they unite with platinum chloride and auric chloride, forming with both double salts.

Several of the ptomaines give color reactions with the strong mineral acids. They are very oxidizable on exposure to the air, and therefore are powerful reducing agents, liberating iodine from iodic acid, and reducing ferric chlorides to the ferrous state; they, therefore, when added to mixed solutions of ferric chloride and ferriyanide of potassium, throw down the dark blue precipitate of Turnbull's blue, a reaction which was until recently thought to be characteristic of ptomaines, and to differentiate them from the vegetable alkaloids; but Gautier has shown that apomorphine and muscarine act in a similar manner. Gautier states, however, that the negative test can be used to differentiate with certainty the ordinary vegetable alkaloids from ptomaines.

A most important practical point is, whether in medico-legal investigations there is a possibility of confusing a ptomaine produced by decomposition with any of the poisonous vegetable alkaloids that might have been administered or taken during life. I can most emphatically state that it is practically impossible in a medico-legal examination of the viscera for an expert to confuse the very minute quantities of animal alkaloids which have been produced by post-mortem decomposition, or which exist naturally, with any of the vegetable alkaloids which might have been introduced during life.

V. I will now say a few words as to the probable genesis of the contagious diseases. As you are aware, some special micro-organism has been traced, or relegated, by bacteriologists to each contagious fever, and has by many been regarded as the *materies morbi*, the causative factor of the disease, though no explanation has been offered as to how these micro-organisms start their own special disease in the body they have invaded.

Now, one explanation which I have for some time entertained is that after the admission of these micro-organisms into the body, and provided they find the conditions suitable, they live and multiply, and that as a result, or a residuum, of their vital activity, a powerful alkaloidal poison is produced, the toxicity of which is the cause of the symptoms of the disease. If so, each contagious disease would be the result of a fermentative decomposition of albuminous matter within the body, induced by a special micro-organism manufacturing its own peculiar poison for each disease.

In the case of some of the non-contagious diseases, which, at all events at present, we do not believe to depend on the intervention of a micro-organism, it is probable that some abnormal chemical decompositions occur within the body and give rise to a poison, possibly alkaloidal, which exerts a toxic influence on the organism.

Now, can any facts or experiments be adduced in support of these views? Yes; but they are meager, as one would naturally expect considering the primeval condition of this domain, but I think that they are prophetic. Pouchet has extracted from the faces of a cholera patient an alkaloidal body which injected into animals produces slowing of the heart, and later death, followed quickly by *rigor mortis*. The same author has obtained from cultivations of Koch's cholera bacillus traces of an alkaloid which appeared to be identical with the preceding one. Again, from cultivations of the typhoid bacillus Brieger obtained a small quantity of a poisonous alkaloid that he calls *typhotoxine*, and which yielded reactions different from the alkaloids he had previously isolated from putrefying animal matters. Quite recently Dixon Mann, of the Victoria University, has extracted from the abdominal and thoracic organs of a patient dying of typhoid fever, during the third week of the attack, an alkaloid, which was obtained in too small a quantity to enable its composition by ultimate analysis to be determined, but which by its qualitative reactions differs from the typhotoxine obtained by Brieger, although I think it is quite possible that the differences as regards the action of reagents might be caused by impurities or changes induced in the alkaloid during extraction by one or the other worker. Again, Brieger from cultivations of the

* A paper read before the Chemists' Assistants' Association, March 22, by A. P. Luff, M.B., B.Sc., F.I.C., F.C.S., Assistant Physician to the South-West London Hospital; Lecturer on Medical Jurisprudence and Toxicology, and Warden of the College, St. Mary's Hospital.—*Chemist and Druggist*.

tetanus bacillus extracted four ptomaines, all of which when injected into mice produced tetanus.

If this view as to the dependence of each contagious disease on an alkaloidal poison is received with skepticism, as it probably will be by many at first, I would recall the fact that the power of plants to manufacture alkaloids was also first received with a great deal of doubt, and that later a similar hesitation was shown to the admission of animals, also possessing this power of forming alkaloids.

The whole subject of the causation of the contagious fevers is at present enveloped in an almost Egyptian darkness, but through this darkness the light of chemical science is beginning to struggle. Chemistry has commenced the exploration of this dark continent of disease, and to those who employ this science as a means with which to search carefully and diligently, I feel hopeful that it will reveal the actual poisons of these diseases. If we become acquainted with these poisons and their properties, is it too much to hope that we shall be able to directly treat fevers, and so remove the reproach that, in the case of the contagious fevers, the medical man is obliged to stand by helpless and merely treat untoward symptoms that may arise? If a further knowledge of the animal alkaloids leads us in this direction, an immense progress in medical and in chemical science will have been made, and the truth of Bacon's axiom will once more be manifest, that "The end of knowledge is the well being of the human race."

THE CHEMICAL EXAMINATION OF RESINS.

THE various resins used in the preparation of varnishes are usually recognized rather by their physical properties of color, hardness, weight, and melting point than by their chemical reactions. Many chemists have, however, within the last few years been investigating this subject, partly from a theoretical point of view, and partly in the hopes that some simple analytical method may be devised for determining the true value of a sample of any resinous body. The resins include a large class of gums and vegetable products of different chemical composition, and little is at present known with regard to their constitution. The microscopic structure of a resin also often affords a ready means of approximately determining its nature, and has been dealt with, together with so much as was then known of the chemical behavior of these bodies, in a work by Herr Wiesner, entitled "Die Technisch Verwendeten Harze und Gummiarten." In this book we find enumerated the solubilities of the various resins in different solvents, and their behavior toward the common alkalies, concentrated sulphuric acid, and the odors described which are obtained on warming and burning most of them. Herr Schmidt and Erbau have endeavored to develop what we may term the analytical examination of resins, and the methods employed by them, and their more important results, seem to be of importance to those engaged in this branch of technology.

Herr Kottstorfer and V. Hubl drew attention to the fact that the resins are saponified by boiling with a solution of potash dissolved in alcohol, and that a given resin required always, approximately the same amount of a standard solution of such alcoholic potash to effect its decomposition. The quantity of potash consumed in this way will be therefore a rough measure of the purity of a given sample of a resin, if one be acquainted with the amount required when a genuine specimen is used. The resins, when dissolved in alcohol, give solutions which are slightly acid, and this acidity can be readily estimated by titration with a standard solution of alcoholic potash. The real amount of potash required to effect the saponification of the resin will therefore be the difference between this number and Kottstorfer's, which obviously gives the amount of potash required to first neutralize and then saponify the resin. A third important reaction has also been put into a quantitative form by Herr v. Schmidt and Erbau. Resins combine with iodine.

Therefore, by adding a standard solution of iodine to a known weight of resin, and determining the amount consumed by titrating the residual quantity of iodine with a standard solution of hyposulphite of soda, we get a third number, which gives us information concerning the quality of the resin under examination. This standard iodine solution is prepared by dissolving 25 grm. of pure iodine in 500 cub. cm. of alcohol, free from fusel oil, and adding it to a clear solution of 30 grm. of mercuric chloride in the same quantity of alcohol. The other solutions employed are standard solutions of half normal hydrochloric acid and caustic soda, and a solution of hyposulphite of soda, containing about 34 grm. in the liter. A semi-normal potash solution in alcohol is also required, and is made by dissolving 25 grm. of caustic potash in the least quantity of water, and then diluting with alcohol until the volume is one liter. Phenol-phthalein in alcoholic solution is used as indicator in determining the amount of soda consumed. About 1 grm. of the finely powdered resin is sufficient for each experiment. The numbers obtained when titrating the resins with alcoholic soda show a marked difference with different kinds of resin.

Colophonium is the most strongly acid, and then follow sandarac, gum benzoin, and storax, while shellac, mastic, and dammar cause only a very slight acid reaction. The copals behave differently fused, white copal from Angola having a greater acidity than the red variety, while that from Zanzibar is neutral. Shellac requires the largest amount of alcoholic potash to effect its saponification, while elemi, Zanzibar copal, asphalt, and fused amber only consume a small quantity of the caustic. Venetian turpentine uses the largest percentage of iodine, and this substance and colophonium are the only two resinous bodies so far examined which consume more than one hundred parts of the iodine solution. Dragon's blood, mastic, storax, and gum benzoin require nearly equal amounts of this reagent, while shellac, fused amber, the copals, and asphalt are represented by low numbers.

The resins, when purified from their solutions in alcohol or oil of turpentine, by precipitating them by means of steam, give different numbers, which afford a means of checking those obtained from the natural product. When two or three resins have been mixed together for commercial purposes, a convenient method for qualitatively determining what resins are present is based upon their different behavior with

certain solvents. Alcohol does not dissolve amber or the copals, except red and white fused Angola, which is partly soluble; while mastic, shellac, sandarac, elemi, Venetian turpentine, colophonium, and gum benzoin are readily soluble, asphalt, dammar, dragon's blood, and storax are only slightly soluble in this solvent.

After having effected a partial separation by means of alcohol, the behavior of other solvents, such as benzole, carbon bisulphide, ether, ligroin, acetone, and amylalcohol is observed, and in this way all the common resins are easily identified. Shellac is the only resin which is not soluble in chloroform. By means of the quantitative method which we have briefly described, it is possible to ascertain the amount of mastic in a mixture of sandarac and mastic, or of shellac when mixed with colophonium, or the amount of colophonium, dammar, and mastic in a mixture of the three. Similar results to those of Schmidt and Erbau have been obtained by Dr. Kremel, proving that these methods are reliable, and therefore of commercial value.

PRESERVING BLOOD IN FLUID STATE.

PROF. J. B. HAYCRAFT and Dr. E. W. Carlier recently gave before the Royal Society a demonstration of a method by which human blood may be withdrawn from the body and its fluidity preserved. Castor oil is the medium in which the blood is suspended. The finger from which the blood is obtained is greased and plunged in the oil before the puncture is made, every precaution being taken to prevent contact of the blood with the air or with solid matter. In this way the blood may be preserved in a fluid state for a considerable time. As the drops of blood settle slowly in the oil, the corpuscles are seen to fall to the lower part of the drops, while the clear plasma remains above. Prof. Haycraft and Dr. Carlier believe that the human blood plasma has never before been demonstrated in an unaltered condition except in microscopic quantity. Coagulation eventually occurs, because the blood necessarily comes in contact with the sides of the wound made in the finger.

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